IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF NORTH CAROLINA
SOUTHERN DISTRICT
No. 7:23-CV-897

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IN RE: :
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CAMP LEJEUNE WATER LITIGATION :
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This Document Relates to: :
ALL CASES :
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Videotaped deposition of Mustafa Mehmet Aral, taken at the offices of Weitz & Luxenberg, 700 Broadway, New York, New York, before Clifford Edwards, Certified Shorthand Reporter and Notary Public, in and for the State of New York on Thursday, February 6, 2025, at 9:02 a.m. EST.

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A P P E A R A N C E S:
(continued)

ALSO PRESENT:
Ingrid Rodriguez, videographer

VIA ZOOM:
Alex Spiliotopoulos (via Zoom)
Bill Williams (via Zoom)
Corissa O'Neill (via Zoom)
Deanna Havai (via Zoom)
Dennis Reich (via Zoom)
Ed Bell (via Zoom)
Morris Maslia (via Zoom)
Giovanni Antonucci, DOJ (via Zoom)
Haroon Anwar, DOJ (via Zoom)
Kailey Silverstein, DOJ (via Zoom)

EXAMINATION

EXHIBITS

EXHIBITS
(continued)

EXHIBITS

(continued)

(Reporter's Note: Exhibits retained by the court reporter and forwarded to Golkow for production.)

THE VIDEOGRAPHER: We are now on the record.

My name is Ingrid Rodriguez. I'm a videographer for Golkow Litigation Services.

Today's date is February 6, 2025, and the time is 9:03 a.m. This video deposition is being held at Weitz & Luxenberg, in New York, New York, in the matter of In Re: Camp Lejeune Water Litigation in the United States District Court for the Eastern District of North Carolina.

The deponent is Professor Mustafa Aral.

Would counsel please state your appearances for the record?

MS. O'LEARY: Allison O'Leary for the Department of Justice.

MS. HORAN: Alana Horan for Department of Justice.

MR. DEAN: Good morning. Kevin Dean here on behalf of the plaintiffs.

MS. BAUGHMAN: Laura Baughman for the plaintiffs.

MS. BOLTON: Devin Bolton for the plaintiffs.

THE VIDEOGRAPHER: And on Zoom, I have "Alex Spiliotopoulos," "Bill Williams," "Corissa O'Neill," "Deanna Havai," "Dennis Reich," someone who's just "Ed."

MR. DEAN: Ed Bell.

THE VIDEOGRAPHER: Okay.

MR. BELL: Ed Bell.

THE VIDEOGRAPHER: "Giovanni Antonucci," "Haroon Anwar," "Kailey Silverstein," and "Morris Maslia."

The court reporter is Cliff Edwards and will now swear in the witness.

MUSTAFA MEHMET ARAL,

having first been duly sworn, deposed and testified as follows:

(Whereupon, there was a discussion off the record.)

COURT REPORTER: All set. Thank you.

DIRECT EXAMINATION

BY MS. O'LEARY:

Q I'm Allison O'Leary and I'm an attorney for the U.S. Department of Justice. Thank you for being here this morning.

I have a few, just kind of, logistics points to go over with you.

So if you don't understand a question, you can ask me to clarify. Can you do that?

A Sure.

Q And do you understand that the court reporter here is transcribing what you are saying today?

A Yes.

Q And do you understand that the videographer is also recording your deposition today?

A Yes.

Q Do you understand that your testimony in today's deposition could be used in court?

A Yes.

Q And do you understand that you are under oath to testify truthfully?

A Yes.

Q Okay. Is there anything today that is impeding your ability to testify?
A No.
Q Did you do anything to prepare for today's deposition?
A We had a meeting yesterday.
Q When you say "we," are you re- referring --
A These three attorneys on this side.
Q Okay. So you are indicating the plaintiffs' attorneys?
A Excuse me?
Q You are -- you are indicating the plaintiffs' attorneys?
A Yeah. Yeah.
Q Okay.
A Of course.
Q And did you review any documents to prepare for today?
A From yesterday to today or early --
Q No, just in general.
To prepare for today's deposition, did you review any --
A Yeah. I --
Q -- documents --

A -- reviewed my expert's report.
Q Your report?
Did you review any other expert reports?
A Much earlier --
Q Okay.
A -- than two days.
Q Much earlier?
What other reports did you review?
A Probably in -- last month.
Q Okay. Which reports did you review last month?
A Okay. I have reviewed Dr. Konikow's report, Dr. Sabatini's report, I have reviewed Alex Spiliotopoulos' report, I have -- I have reviewed Dr. Hennat's report, Morris Maslia's report, Morris Maslia's deposition.
I don't remember the name but there's a historian expert on the -- the -- the government side. I didn't review that because that's a historical review. It's not my area.
I believe that's it.
Q Okay. And you said you'd reviewed Morris Maslia's deposition; is that right?
A Yeah.
Q Was that his deposition from 2024?

A I think -- let's see.
No. No. It's a -- did I say a deposition?
Q I thought you had said the transcript from Morris Maslia's deposition?
A I read Morris Maslia's rebuttal report --
Q Oh, rebuttal report?
A Right.
Q Okay.
A I -- I was mistaken on that. And I read his expert report.
Q Okay. Thank you for clarifying. You mentioned you had reviewed reports.
Is there anything from your report in this case that you'd like to correct?
A No.
Q Okay. Did you review any reports by Norman Jones and Jeffrey Davis?
A Oh, yes. That's the post audit --
Q Okay.
A -- study.
Yes, I did review that.
Q Did you read the rebuttal report and the original report by Norman Jones and Jeffrey --
A Yes.

Q -- Davis?
A Both of them.
Q Okay. And am I correct that the only report you prepared in this is the report that came out last fall in --
A Yes.
Q -- 2024?
A The expert report.
Q Okay. So do I understand correctly that you are not offering opinions on Dr. Konikow's or Dr. Sabatini's rebuttal reports?
A No. I mean, I didn't write a rebuttal report to their --
Q Okay.
A -- expert report.
Q Okay. So you have not offered a -- a rebuttal report?
A No. No.
MS. O'LEARY: And can we get number eight?
I'm sorry. There will be a little delay as we pull out documents --
THE WITNESS: Okay.
MS. O'LEARY: -- and get them marked.

THE WITNESS: Okay.

(Whereupon, there was a discussion off the record.)

(Whereupon, Government's Exhibit Aral 1, Résumé of Professor Aral, was marked for identification.)

BY MS. O'LEARY:

Q Professor Aral, I've handed you what's marked as --

A Can you speak a little bit --

Q Yeah.

A -- louder?

Q I'm sorry.

A Okay.

Q Professor Aral, I've happened you what's been marked as Government Exhibit 1.

Do you recognize this document?

A It looks like my résumé.

Q Okay. Is there anything on this résumé -- on this résumé that you'd like to correct?

A No.

Q Okay. And do I understand correctly that you were approached about serving as an expert in this Camp Lejeune Justice Act litigation by Morris Maslia?

A No. By Kevin.
Q Oh, by Kevin.
Kevin Dean?
A Yeah, Kevin Dean.
Q When was that?
A Probably two years ago, maybe. I'm not sure.
Q Okay. Why did you decide to --
A The -- the reason I think you mentioned Morris Maslia is that Morris Maslia introduced me to Kevin.
Q Oh, okay. I understand.
A Okay.
Q Thank you. And why did you decide to serve as an expert in the Camp Lejeune Justice Act litigation?
A Well, because I did a lot of work at Camp Lejeune.
Q Okay. Are there any other reasons why you decided to serve as an expert?
A No.
No.
Q No? Okay.
And am I correct that you've been retained, specifically, by the Bell Legal Group?

A Yes. My contract with -- is with the Bell --
Q Okay. And did --
A -- Group.
Q -- that contract begin in August of 2022?
A Probably.
Q Prob- -- okay.
Prior to that contract beginning with Bell Legal Group, had you communicated, either verbally or through writing like e-mail, with anyone from the Bell Legal Group?
A No.
Q Had you communicated prior to being retained by the Bell Legal Group with anyone from Motley Rice?
A No. No.
Q And prior to being retained by the Bell Legal Group, had you communicated with any attorney related to Camp Lejeune?
A No.
Q Okay.
A As far as I know -- I mean, I have attended expert panels. They may be there. I may have exchanged some ideas.
I'm not sure.

Q Okay. You don't recall --
A No --
Q -- specifically?
A -- I don't recall.
Q Prior to being retained by the Bell Legal Group in the Camp Lejeune Justice Act litigation, did you have any communications with a man named Mike Partain related to Camp Lejeune?
A I think I communicated with -- not communicated but talked to him in year 2005, maybe.
Q Where was it that you spoke to him?
A Expert panels.
Q And what did you speak to Mike Partain about?
A I don't recall.
Q After the 2005 expert panel, had you communicated with Mike Partain again prior to being retained by the Bell Legal Group?
A No.
Q And prior to being retained by the Bell Legal Group, did you communicate with a person named Terry Dyer about anything related to Camp Lejeune?
A Terry Dyer?
Q Yes.
A No.

Q Have you ever communicated with United States Senate or House of Representative members related to Camp Lejeune?
A No.
Q And have you ever communicated with Dr. Frank Bove about Camp Lejeune?
A Yes.
Q And in what sorts of contexts?
A Again, expert panels, some meetings probably at the ATSDR starting from 2005.
Q Okay.
A But when you say "communication," this is verbal, meeting communications, not e-mails, etc. I don't --
Q No, I mean both.
Like --
A You mean both? Okay.
Q Yeah. So does that change your answer --
A I may --
Q -- for Mike Partain?
A I may have received e-mails from ATSDR, which included his name as well.
Q Included --
A Frank --
Q -- Mike Partain?

A No. No.

Frank Bove.

Q Frank Bove?

A Frank Bove.

Q Okay.

A Yeah.

Q So you may have had e-mails with Frank Bove?

A Yeah. Not personally exchanging e-mails but if they send e-mail to group of people, I may be included into that e-mail.

Q Okay. Did you ever specifically e-mail Dr. Frank Bove?

A No.

Q Okay. And did he ever send you personally an e-mail from --

A I don't recall.

Q Okay. And I understand that you were the director of the Multimedia Environmental Simulations Laboratory at Georgia Tech at some point, is that correct?

A That's correct.

Q And were the years that you were the director 1993 to 2018?

A That's correct.

Q And how do you usually refer to the Multimedia Environmental Simulations Laboratory?
A It's a reser- -- research center at --
Q Do you call --
A -- Georgia --
Q I'm sorry. Go ahead.
A Yeah.
-- at Georgia Tech.
Yeah.
Q Do you call it MESL or M-E-S-L?
A Yeah. MESL.
Q MESL?
A Yeah.
Q And you said it's a research center?
A Yes.
Q Can you explain what area of research it works on?
A Groundwater modeling, surface water modeling, model development, applications off these models in different areas.
Q Is it -- are there anything else it works on?
A Can you repeat that --
Q Yeah.
A -- please?

Q Is there any -- are there any other areas where the MESL works?

A It depends on what type of projects we had during this period. I think we had a project on coastal issues at Georgia. I think we had issue -- or a NSF grant to facilitate a conference related to our studies.

Several other projects may be included in it, which is outside the area of groundwater modeling.

Q And is the MESL still operating?

A I don't think so.

Q Okay. When you were the director -- so 20- -- excuse me -- 1993 to 2018, how many people worked in MESL?

A I had about 25 Ph.D. students; they were all in there. I had -- I had about 60 master's students; they came in and went out during their master programs.

As a faculty member, I was the only one.

Q Okay. And you said about 25 Ph.D. students. Do you mean --

A That's right.

Q -- at once or during the time --

A Oh, during the --

Q -- you were the director?
A -- the time. It takes about five years to get the Ph.D.
Q And for the -- about 60 master's students --
A Yup.
Q -- is that at once or through time?
A Oh, through time. Of course.
Q Okay. Did any other professors work with MESL --
A I answered --
Q -- at a --
A -- that --
Q -- part-time --
(Whereupon, the court reporter requests clarification.)
BY MS. O'LEARY:
Q Yeah. Did any other professors work at MESL on a part-time basis?
A No.
Q Okay. And then I understand you became professor emeritus in 2018, is that right?
A Emeritus.
Q Emeritus?
A Yes.

Q Okay. And what is an emeritus professor?
A A retired professor.
Q Do you teach anything now?
A No.
Q When did you last teach?
A Retired 2019, went to Turkey. I taught there.
Probably 2020. In that range, yeah.
Q Around --
A I was --
Q -- 2000 --
A -- a professor there.
Q At -- did I understand that was not at Georgia Tech?
A No, it wasn't at Georgia Tech, it was in Turkey.
Q Okay. Do you currently supervise any graduate students?
A No.
Q And do you currently do any research?
A Yes.
Q Okay. What types of research do you do now?
A That's like a hobby for me. I do population analysis. I do model development in

different areas. A lot simpler models, but still research. Yeah.
Q Models related to geohydrology?
A Not really. Different areas.
Q Oh. What sorts of areas?
A Population --
Q Oh.
A -- topics.
Q Okay. I understand.
How else do you spend your time now?
A I walk a lot, I exercise a little bit, I visit my grandchildren. That's my total exposure to what I do here in New York, especially.
Q And I'm sorry, I didn't hear the last part?
A I am here in New York to visit my grandson.
Q Oh, okay.
A I live in Turkey most of the time. I live in Atlanta when I visit friends and other relatives in Atlanta.
Q And what city do you live in in Turkey when you are there?
A Istanbul.
Q Istanbul.

What are your income sources in retirement?

A My income?

Q Yeah. What are the sources of your income in retirement?

A Oh, retirement benefits from Georgia Tech.

Q Any others?

A I am paid by this task for Camp Lejeune.

MS. O'LEARY: Okay. And I have a few questions about your report.

So this will Be 33.

So just a minute again as we pull out the exhibit.

THE WITNESS: Uh-huh.

(Whereupon, there was a discussion off the record.)

(Whereupon, Government's Exhibit Aral 2, Report by Professor Aral, was marked for identification.)

BY MS. O'LEARY:

Q And one last question, going back to what your current research that you do on population.

What is the purpose of the research you do on population?

A My interest is general. It covers a lot of areas and that's one of my research interests.

And I do population research, meaning how does the population change, what is the transition from one country to the other, immigration/migration and all that. And I do that in mathematical analysis.

Q Okay. And why is that of interest to you?

A Because I have general interests in many topics.

Q Okay. So if you could go to the fourth page of your report, which is Government Exhibit 2?

A Okay.

Q Do you see a paragraph underneath the bullet points that starts, "Around the year 2000, the Multimedia Environmental Simulations Laboratory, MESL, a research center at the School of Civil and Environmental Engineering, Georgia Institute of Technology, entered into a cooperative agreement with the Agency for Toxic Substances and Disease Registry, ATSDR, Centers for Disease Control and Prevention, CDC, to provide technical support to ATSDR in all aspects of the Camp Lejeune study for all three study areas on an as-needed basis."

Did I read that correctly?
A Yeah.
Q So if that was in 2000, does that mean that when MESL started working with the ATSDR, the ATSDR's water models for Tarawa Terrace and Hadnot Point were not --
MR. DEAN: Also --
BY MS. O'LEARY:
Q -- yet complete?
MR. DEAN: Object to the form.
BY MS. O'LEARY:
Q Did you understand my question, Professor Aral?
A I think you didn't finish your question --
Q Let me -- I'll say it again.
MS. BAUGHMAN: I think it would be good if you would speak a little louder.
THE WITNESS: Yeah.
MS. BAUGHMAN: I don't think he can hear you.
THE WITNESS: Yeah. It --
BY MS. O'LEARY:
Q Sure. Yeah.
A I would prefer --

Q I'll try to --
A -- that, yeah.
Q So that section I just read --
A Yeah.
Q -- from --
A Yeah.
Q -- page four of your report, it says that MESL entered into the agreement with ATSDR in 2000.
MR. DEAN: Object to the form. That's not what the document says.
BY MS. O'LEARY:
Q Is that correct?
MR. DEAN: It says "around."
MS. O'LEARY: That's --
MR. DEAN: Okay.
MS. O'LEARY: -- that's fine, we can make it --
THE WITNESS: Yeah.
MS. O'LEARY: -- around.
Is it --
MR. DEAN: I just want you to understand what I'm -- it's not a -- I'm not trying to interfere, but I'm just objecting to the form because that's --
MS. O'LEARY: Yeah.

MR. DEAN: You said "in 2000,"
that's --
MS. O'LEARY: Yeah.
MR. DEAN: -- not what it says.
MS. O'LEARY: I understand. That's
fair.
THE WITNESS: Okay.
BY MS. O'LEARY:
Q So Professor Aral, is it around 2000 that MESL entered into an agreement with ATSDR?
A Yes. The agreement was around 2000, yeah.
Q Okay. So does that mean when MESL entered into the agreement with the ATSDR, the ATSDR's models for Tarawa Terrace and the Hadnot Point-Holcomb Boulevard area were not yet complete?
A No, of course not.
Q Meaning they were -- it's true they were not yet complete?
A They were not completed, yeah.
Q Okay. And is it true that no other Georgia Tech faculty were part of the cooperative agreement between MESL and the ATSDR?
A There's no other faculty involved.
Q Did the MESL enter into cooperative

agreements with any other entities besides the ATSDR?
A Of course. Many.
Q Okay. What was the scope of those agreements with other entities?
A Other research topics, which is summarized in my résumé.
Q Okay. Other than in the work you did with the ATSDR on Camp Lejeune, have you ever been asked in a cooperative agreement to calculate historic contaminant levels on a monthly basis?
A That was the purpose of our modeling, overall.
Q You mean at -- at Camp Lejeune that was the purpose?
A Yeah, at Camp Lejeune.
Q Yeah?
A Yeah.
Q So other than at Camp Lejeune, did the MESL ever work on projects that were calculating historic contaminant levels on a monthly basis?
A We had several models which used different time frames, different time intervals. Some of them may be monthly, yeah.
Q Okay. Do you recall any that were --

A I don't recall.
Q -- monthly?
A No.
Q Do you recall any that were shorter time frames than monthly?
A Yeah, of course.
Q What's an example of one that was a shorter time frame?
A Surface water modeling that we did. We may have used shorter time frames.
Q Surface modeling of what?
A I think that was a coastal aquifer around Savannah, I believe.
Q And who was requesting that coastal aquifer modeling around Savannah?
A That was the research center at University of Georgia.
Q And what was the timescale on the model?
A I don't recall exactly but we may have used different timescales to answer different questions.
Q What was the purpose of that model?
A It's a contaminant transport analysis.
Q But why did they want to know about the --

A No.

Q -- contaminate --

A We wrote --

Q -- transport?

A -- a proposal to develop a model, a generic model in a coastal application, and they agreed to fund it.

Q Right. And what were they using it for?

A I have no idea.

Q Okay. And was that a historical model?

A It's a groundwater model. A research center proposes a topic --

Q Uh-huh.

A -- to a funding agency. If they like it, they approve it; if they don't like it, they reject it.

Q And what you proposed, was that to do a -- a model that would look at times in the past or look at going forward?

A No. It was a generic model. It can be used for the time in the past and future predictions.

Q Okay. Do you know if it was going to be used for past predictions?

A I don't know what they have used it

for --

Q Okay.

A -- but it's a generic model.

Q Uh-huh.

A It can be used.

Q You can run it forwards or backwards --

A Yeah.

Q -- is that what you mean?

A Yeah.

I don't know what you mean, by the way, "backwards."

Q I mean, to estimate things that happened in the past.

A Starting from today going backwards, is that what you mean?

Q I mean, starting from whenever the model is calibrated to.

A Okay.

Yeah, it can be used --

Q To go --

A -- for that purpose --

Q -- in the --

A Yeah.

Q I'm sorry. I just --

A To predict -- it can be used to predict

historical behavior or future behavior.

Q From the time of calibration?

A Yup.

Q Okay. But for the coastal aquifer surface modeling project, you don't know if it was going to be used for going backwards from the time of calibration or forwards?

A I don't know what they have used it for.

Q Other than your work in Camp Lejeune, were you ever asked to calculate contaminate levels more than 25 years before the time the -- of calibration of the model?

A No.

Q Other than at Camp Lejeune, have you ever been asked to model all of mass loading, groundwater flow, contaminant fate and transport, and variable multiwell pumping mixing models?

A In several research applications we have worked at MESL, all of those models were developed or applied in -- in an integrated manner or a application of each model, separately. Two different ways.

Q I'm not sure I understand.

So are you saying that all of those types of models have been done at MESL at some time?

A No. We use generic models as well, coming from other sources.

Q But did -- did the mass loading, groundwater flow, contaminant fate and transport, and variable multiwell pumping mixing models that MESL did, were those done together in one project or were those used in --

A Oh, no.

Q -- individually or --

A If you -- if you are referring to TechFlowMP, for example, that's a generic model we have developed --

Q Uh-huh.

A -- for use in different projects, not for Camp Lejeune. But we used it for Camp Lejeune as well.

Q And had -- in any other projects, not Camp Lejeune so other projects -- have you used TechFlowMP in combination with modeling mass loading and groundwater flow and, like, a well pumping mixture model?

MR. DEAN: Object to the form of the question.

A TechFlowMP is a generic model which starts from groundwater modeling --

BY MS. O'LEARY:
Q Uh-huh.
A -- all the way to contaminant transport modeling, within itself.
Q But it doesn't involve mixing, is that correct?
A What do you mean by mixing?
Q Like, mixing of multiple wells, that's not a part of TechFlowMP.
A Why shouldn't it? It will, of course.
Q How does TechFlowMP model well mixing?
A Well, because you have -- in an area you have water supply wells. You put them into the model as a discharging point or a source point --
Q Uh-huh.
A -- and the whole thing is integrated in a single application.
Q But doesn't TechFlowMP model the contaminant movement to the wells, not the mixing of the wells?
A Oh, you are talking about mixing of the wells in a water treatment plant --
Q That's right.
A -- is that right?
Q That's right.

A Okay. Let's clarify that.
Q Okay. So --
A So what is your question?
Q So TechFlowMP does not model, like, mixing of wells in a water treatment plant?
A No, it does not.
Q All right. Other than at Camp Lejeune, have you done any other projects where what MESL was doing was using TechFlowMP coupled with something to model mixing in a water treatment plant?
A Not a water treatment plant.
Q Was it used in conjunction with something other than a water treatment plant?
A Yeah. We -- we used it in an application, like how to treat contaminated sites.
Q Like a remediation project?
A Yeah. As a remediation project.
Q Okay. And am I correct that you have not tested --
A Please speak louder.
Q I'm sorry.
Am I correct that you have not testified or been deposed in the last four years?
A That's correct.
Q Have you ever been deposed before?

A No.
Q Have you ever testified at a trial?
A Can you speak louder, please?
Q I'm sorry.
MS. BAUGHMAN: You are not speaking louder. You keep speak --
MS. O'LEARY: Yeah.
THE WITNESS: You have a very --
MS. O'LEARY: Well --
THE WITNESS: -- soft voice.
MS. BAUGHMAN: He can't hear you.
MS. O'LEARY: So can you hear me, ma'am?
THE VIDEOGRAPHER: I can --
MS. O'LEARY: Can you hear me, Mr. Court Reporter?
COURT REPORTER: Sorry?
MS. O'LEARY: Can you hear me?
COURT REPORTER: Sure.
MS. O'LEARY: I'll try and speak louder but it seems that my voice is coming through.
MR. DEAN: Because you have a --
MS. BAUGHMAN: He doesn't have the same hearing level, okay? He's retired.

MS. O'LEARY: Yeah.
MS. BAUGHMAN: You need to speak louder.
BY MS. O'LEARY:
Q So have you ever testified in a trial?
A No.
Q Have you ever testified in any other setting?
A Not a setting like this.
Q Like a --
A Not --
Q -- a deposition?
A -- not --
Like a deposition, no.
Q Have you testified in some setting that's different than this?
A Yeah. We had a face-to-face dialogue with a opposing expert and me on the other side.
Q In what case are you talking about?
A I'm talking about Atlanta Gas Light pollution problem.
Q Okay. And when was that face-to-face?
A I don't recall exactly but it must be late 1990s.
Q And were you an expert for one of the

sides in that Atlan- -- Atlanta Gas Light pollution problem?

A I was one of the experts on the other side of the Atlanta Gas Light pollution problem or --

Q Who is on the other side? I'm not sure what you mean.

A Some law firm hired me to question the work done at the Atlanta Gas Light site.

Q Okay. And then you had a sitdown with the expert from the --

A Right.

Q -- Atlanta Gas Light site?

A Exactly.

Q Okay. Other than that Atlanta Gas Light site, have you ever served as an expert before for some sort of dispute?

A Not for a dispute but I served for expert -- as an expert in other studies.

Q What does it mean to serve as an expert in other studies?

A A consulting company comes and asks me as to what I think about this and that related to environmental pollution. It doesn't have to be groundwater. I offer my opinion --

Q Uh-huh.
A -- and that's a expert opinion.
Q Okay. And when was the last time you did that sort of consulting?
A Probably it was my work with Geosyntec. I don't recall the time, it's in my résumé.
Q And you said Geosyntec?
A Yeah, Geosyntec.
Q All right. Do you have any family members who filed claims under the Camp Lejeune Justice Act?
A No.
Q And do you have any acquaintances who have filed claims under the Camp Lejeune Justice Act?
A No.
Q Huh. And you can turn back to the same exhibit, so this is Government Exhibit 2, to page 49.
A Yes.
Q And in the last paragraph, so near the bottom of the page --
MR. DEAN: What page are you on?
MS. O'LEARY: Forty-nine.

BY MS. O'LEARY:

Q The last paragraph, do you see where it says, "It is important to note that the review comments I am providing below are only associated with the water-modeling aspects of the ATSDR health study and the NRC report and do not cover any epidemiologic study aspects since those topics are outside my ar- -- expertise areas."

Did I read that correctly?

A Yes.

Q Is that accurate that epidemiologic studies are outside your expertise areas?

A That's correct.

Q Does it follow that the level of detail on exposure data needed for an epidemiological case control study is not within your area of expertise?

MR. DEAN: Object to the form.

A Yes. I -- I don't know what they would need.

BY MS. O'LEARY:

Q Okay.

A I'm told what I should do, so I do it.

Q And is it accurate then that the level of detail on contaminant exposure to an individual needed to render an opinion on causation from

contaminant exposure is not within your area of expertise?

A It's not. It's not within my area.

Q Okay. And do you agree that you are not an expert on whether a contaminant can cause a disease?

A I think you have to clarify that question.

Q Is that something that you render -- have ever, like, done consulting opinions on, on whether a contaminant can cause a disease?

A No, I did not.

Q And is that something that your university training study was -- was whether contaminants can cause a disease?

A That's a generic question, "contaminants." I'm not going to respond to that.

Q Well, do you study whether certain chemical compounds cause diseases?

A All foreign environmental contaminants will have some adverse effects on human health.

Q And how do you know that?

A Well, that's -- in terms of the literature that I have reviewed, in terms of the research work that I have done, that information was

made available to me.

Q So that's something you know from reading literature?

A That's right.

Q Okay. Have you ever studied epidemiology?

A No.

Q Your report, Government Exhibit 2, discusses maximum contaminant levels or MCLs. Do you know what I'm talking about?

A Yeah.

Q And do you understand that maximum contaminant levels are set by the Environmental Protection Agency, the EPA?

A That's correct.

Q Have you ever been involved in the setting of an MCL?

A No.

Q Are you familiar with the methodology that the EPA uses to establish MCLs?

A No.

Q Are you familiar with how MCLs are related to health risk?

A No.

Q Why did you discuss MCLs in your report

in this litigation?
A Because that was the criteria set by ATSDR.
Q So ATSDR asked you to consider MCL levels in the water modeling?
A I didn't consider MCL levels. I just predicted a continuous contaminant transport. Whether it's higher or lower, that was decided by ATSDR, right?
Q Higher or lower than --
A MCL.
Q -- like an MCL?
Okay.
A Right.
Q I understand, I think.
And am I correct that for your work on the Camp Lejeune Justice Act, you've been paid $600 per hour?
A That's correct.
Q How many hours, approximately, have you worked on the Camp Lejeune Justice Act litigation?
A I have to check my billing.
Q Do you think it's more than 50?
MR. DEAN: Object to the form.
You have the invoices.

BY MS. O'LEARY:
Q Do you think it's more than 50 hours?
A Probably. I don't --
Q Okay.
A -- recall.
Q Do you think it's more than a hundred hours?
MR. DEAN: Object to the form.
A I don't recall.
BY MS. O'LEARY:
Q You don't recall? Okay.
Do you know -- sorry.
Have you received any compensation related to the Camp Lejeune Justice Act other than your work as an expert witness?
A From?
Q Well, from any source? So other than your work as an expert witness.
A A -- A -- ATSDR funded the corporate agreement --
Q And --
A -- but I didn't get personal income from that, Georgia Tech did.
Q So when you were working at MESL on Camp Lejeune, was your salary paid by Georgia Tech?

A Repeat that, please?
Q When you were working on Camp Lejeune water modeling --
A Right.
Q -- at MESL --
A Right.
Q -- was your salary paid by Georgia Tech?
A My salary was, of course, paid by Georgia Tech.
Q Did the ATSDR fund MESL's work on Camp Lejeune?
A That's correct.
Q Okay. Are you familiar with a -- a text by Dougherty (phonetic) from 2015?
A Which text?
Q The one from 2015?
A I'm sure he has written many texts.
Q Okay. Is Dor- -- does Dougherty have a good reputation in the fields you work in?
MR. DEAN: Object to the form of the question.
A I don't recall who Dougherty is.
Does he have a first name?
BY MS. O'LEARY:
Q Are you familiar with Panko and Cherry

(phonetic)?

A Yeah.

Q All right. Their 1996 text, is it considered a reliable authority in your field?

A As good as any other reference textbooks.

Q Okay. So I have some -- a few questions about the extent of your involvement in the ATSDR's water modeling.

A Right.

Q But I just wanted to see, would you like to take a break or are you okay to keep going?

A I'm okay.

Q All right.

MS. O'LEARY: So if we could get -- that would be 56.

So this will end up being Government Exhibit 3.

(Whereupon, Government's Exhibit Aral 3, Tarawa Terrace Chapter A Report, was marked for identification.)

BY MS. O'LEARY:

Q And Professor Aral, if you could go to the page that's numbered A6 in the -- it will be in the bottom left?

All right. Do you see a table that says,

"Table A2, Summary of ATSDR Chapter Reports" --
A Uh-huh.
Q -- at the top?
Okay. And am I understanding correctly that table A2 lists the chapter reports from the ATSDR water modeling on Tarawa Terrace?
A Yeah. These are the --
Q Okay. And --
A -- reports, yeah.
Q -- as I look at this table, it looks like you authored -- you are an author on chapter A, "Summary of Findings"; chapter G, "Simulation of Three-dimensional Multispecies Multiphase Mass Transport of Tetrachlorethylene and Associated Degradation Byproducts"; chapter H, on "The Effect of Groundwater Pumping Schedule Variation on Arrival of Tetrachlorethylene at Water Supply Wells at the Water Treatment Plant"; chapter I, "Parameter Sensitivity Uncertainty and Variability Associated with Model Simulations of Groundwater Flow Contaminant Fate and Transport" --
(Whereupon, the court reporter requests clarification.)
BY MS. O'LEARY:
Q -- "and Distribution of Drinking water."

And then Chapter K, "Supplemental Information."
Is that correct that those are the only chapters you authored on the ATSDR reports?
A I didn't author, I contributed to them.
Q Okay. So I see on table A2, that you are listed as an author for those ones. What is the difference to you between contributing to a report and being an author?
A There are several other names, probably. The names that I see, for example, in G --
Q Uh-huh.
A -- it's a -- a graduate student of mine and me.
Q All right. So you both --
A So we --
Q -- wrote that?
A -- we both contributed to that.
Q Okay. And what role if any did you have in writing or reviewing the other chapters from table A2 where you are not listed as an author?
A Probably I have looked at them, reviewed --
Q What do you mean, you looked at them?
A Reviewed them.

Q And reviewed them for what purpose?
A For my understanding of what they are doing.
Q Okay. Did you offer comments on chapters you did not author -- you are not listed as an author on this table?
A I don't recall but I could have.
Q Okay. And --
MR. DEAN: For correction of the record, chapter K was never issued or published.
BY MS. O'LEARY:
Q So Professor Aral, what was Morris Maslia's role in the Tarawa Terrace water modeling project for ATSDR?
A He was the lead person at exposure of those reconstruction -- reconstruction program at ATSDR.
Q Okay. And were you happy with the performance of the team working on the Tarawa Terrace modeling at ATSDR?
A Yes.
MR. DEAN: Object to the form.
A Yes.

BY MS. O'LEARY:
Q And did you have any role on chapter J, "Field Test Data Analysis and Simulation of the Distribution of Drinking Water"?
A I think that's the least contribution that I had in any of these reports.
Q Was chapter J?
A Yeah.
Q Were you involved in data collection for the Tarawa Terrace water modeling?
A No.
Q Okay. Why were you not involved?
A Because they didn't ask me. I didn't go to the site, that's why.
Q Were you involved in field test design?
A No.
Q And have you been to Camp Lejeune?
A No.
Q And just one question about chapter K that Mr. Dean brought up.
Do you consider that chapter finished?
MR. DEAN: Object to the form of the question.
The chapter was never issued.
A I -- I don't recall that chapter at all.

MS. O'LEARY: Okay. And you can set aside Exhibit 3 for a moment and we are going to pull out -- this is 42.

That will be exhibit -- Government Exhibit 4.

(Whereupon, Government's Exhibit Aral 4, Document, was marked for identification.)

THE WITNESS: Uh-huh.

BY MS. O'LEARY:

Q And Professor Aral, if you could go to page A4?

A Eighty-four?

Q A4.

MR. DEAN: A4.

A A4?

BY MS. O'LEARY:

Q "A," as in chapter A.

A Yes.

Q All right. Do you see, starting on A4 and going onto page A5, table A1, summary of ATSDR chapter reports and supplemental information sections for the Hadnot Point-Holcomb Boulevard study area?

A Yup.

Q Okay. And looking at this table, it seems to show that you -- you are listed as an author for chapter A, "Summary and Findings"; sup- -- I guess it's chapter A, supplement two, "Development and application of a methodology to characterize present day and historical water supply well operations"; supplement five, "The theory, development, and application of Linear Control Model Methodology to Reconstruct Historical Contaminant Concentrations at Selected Water Supply Wells"; supplement seven, "Source characterization and simulation of the migration of light nonaqueous phase liquids in the vicinity of the Hadnot Point industrial area"; and supplement eight, "Field test data analysis and simulation of the distribution of drinking water with emphasis on intermittent transfers of drinking water between the Hadnot Point and Holcomb Boulevard water distribution sys- --"

Is that correct that those are the --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q Holcomb Boulevard water distribution.

Is that correct, Professor Aral, that those are the only chapters where you were listed as

an author?

A Yeah.

Q And similarly, did you contribute to those or did you author the whole thing?

A No, I contributed to them.

Q Okay. And in supplement eight, what field tests were involved in that?

A The field tests probably refers to the field studies that ATSDR has done on Camp Lejeune. I'm not involved in that. However, intermittent transfers of drinking water between the Hadnot Point and Holcomb Boulevard water distribution system is the part that I have contributed.

Q Okay. And were you involved in collecting historical data about the water distribution systems at Hadnot Point and Holcomb Boulevard?

A No.

MR. DEAN: Object to the form.

A No.

BY MS. O'LEARY:

Q Did you personally review historical documentation about the operations of the Hadnot Point/Holcomb Boulevard water distribution system?

A The intermittent transfer issue or the

operation of the water treatment plant?

Q Let me break that down farther.

A Okay.

Q So were you involved in reviewing historical documentation about intermittent transfers between the Hadnot Point area and Holcomb Boulevard areas?

A I have reviewed the data that was collected at the --

Q Okay.

A -- site.

Q Did you review data collected at the site other than for those intermittent transfers?

A Yes.

Q Okay.

A Several of them. Yeah.

Q And what sorts of things did you review other than for the intermittent transfers?

A Water treatment plant data --

Q Uh-huh.

A -- groundwater levels data, pumping data of supply wells --

Q Uh-huh.

A -- data collected from observation wells, any other data that was given to me in terms of

doing what we did at Georgia Tech.
Q Were --
A Yeah.
Q Thank you. I think I understand.
Were you personally involved in collecting that data --
A No.
Q -- that you reviewed?
A No.
Q Okay. Okay.
Thank you. You can set aside that exhibit --
A Uh-huh.
Q -- for now. And a few more questions about your role in the water modeling with ATSDR.
First about some of the people you worked with. So starting with Morris Maslia --
A Yes.
Q -- how long have you known Morris Maslia?
A I think he was a graduate student at Georgia Tech.
Q How many projects have you worked on together over the years?
A I worked as a consultant at Geosyntec. I think he was working at Geosyntec at that time, as

well.

Q Were there any other things besides the Geosyntec work?

A Other than conclusion, I don't recall.

Q Okay. Do you consider Morris Maslia a friend?

A Yes, of course.

Q Do your families know each other?

A No.

Q When's the last time you spoke to Morris Maslia about anything other than the Camp Lejeune Justice litigation?

A We had dinner several years ago in Atlanta.

Q Okay. Was that dinner before or after you'd been retained as an expert in the Camp Lejeune Justice Act litigation?

A I don't recall, honestly.

Q Have you ever served as a reviewer on any journals or a member of any committees that gave an award to Morris Maslia for his work?

A No.

Q Were you ever a reviewer on the American Society of Civil Engineers Water Planning and Management?

A Probably.
Q Okay. And --
A I have been a reviewer for many journals.
Q Okay. Which journals have you been a reviewer for?
MR. DEAN: Object to the form.
A It's in my résumé. It's about two pages long.
BY MS. O'LEARY:
Q Okay. Were you a reviewer of the ASCE Journal of Water Resources and Management in 2000?
A I could have been.
Q Were you a reviewer of the ASCE Journal of Water Resources and Management when they published a study about the ATSDR's modeling work on Dover Township --
A Not on that --
Q -- Toms River?
A Not on that study.
Q What do you mean, "not on that study"?
A I mean, that wasn't submitted for my review.
Q Ah. You mean you didn't review that --
A No.
Q -- study?

But you were a reviewer on the ASCE Journal of Water Resources and Management at the same time?

A Yeah. If they send me a paper to review, I do that.

Q Okay. Were you the editor in chief of the journal, Water Quality, Exposure and Health in 2009, when it published a study about the ATSDR's work on the Tarawa Terrace modeling?

A That's correct.

Q Were you a reviewer of the journal, Water, in 2016 when they published a study about the ATSDR's work on the Hadnot Point/Holcomb Boulevard --

A No.

Q -- area model?

A No.

Q And were you Morris Maslia's professor when he was getting a master's degree at Georgia Tech?

A Yeah, I think I was. Yeah.

Q Would you consider yourself Morris Maslia's mentor when he was getting that master --

A Can you --

Q -- degree?

A -- speak louder, please?
Q Sure.
Would you consider yourself as having been Morris Maslia's mentor when he was getting his master's degree?
A Yes.
MS. O'LEARY: We had -- this will be number nine and will be Government Exhibit 5.
(Whereupon, Government's Exhibit Aral 5, Document Regarding Development of Environmental Management Models, was marked for identification.)
(Whereupon, there was a discussion off the record.)
MR. DEAN: Dr. Aral, if you have any difficulty whatsoever hearing the question, don't hesitate to tell her she's talking too softly --
THE WITNESS: Okay.
MR. DEAN: -- to confirm. I know it's kind of repetitive, but do it anyway.
THE WITNESS: Okay.

BY MS. O'LEARY:
Q So Professor Aral, I've handed you what's been marked as Government Exhibit 5.
Do you recognize this document?
A Yes, I do.
Q What is this?
A It just talks about the development of environmental management models over the years.
Q Okay.
A And I'm trying to explain how it evolved into the present day analysis.
Q And did you author this?
A I see my name on it.
Q But do you recall authoring this?
A Yes, of course.
Q Okay.
MS. O'LEARY: And if we could take a break for about five minutes, I need to...
THE WITNESS: Okay.
MS. O'LEARY: Just a minute.
THE VIDEOGRAPHER: The time right now is 10 a.m. We are off the record.
(Whereupon, there was a recess taken from 10:00 a.m. to 10:09 a.m.)

THE VIDEOGRAPHER: The time right now is 10:10 a.m. We are back on the record.
MS. O'LEARY: All right. Thank you.
BY MS. O'LEARY:
Q And Professor Aral, just to remind you, you remain under oath.
Do you understand?
A Okay.
Q Okay. So we are going to set aside that exhibit and I'm going to hand you a different one.
MS. O'LEARY: This will be Government Exhibit 6.
(Whereupon, Government's Exhibit Aral 6, Environmental Modeling and Health Risk Analysis, by Mustafa M. Aral, was marked for identification.)
BY MS. O'LEARY:
Q Professor Aral, the front page of this says, Environmental Modeling and Health Risk Analysis (Acts/Risk), and it has your name, "Mustafa M. Aral."
Do you know what Environmental Modeling and Health Risk Analysis (Acts/Risk) is?
A Yes.

Q What is it?
A Environmental modeling is a procedural analysis of environment using models. Health risk analysis is another procedural use of health risk effects --
Q Okay.
A -- of environmental contaminants.
Q And if -- as you look through Government Exhibit 6, does this looks like excerpts from a textbook that you authored?
MR. DEAN: Object to the form of the question.
You used the term "excerpts." I'm just pointing out this is not the whole text, it goes to page 16.
A Yes, it looks like parts of it. Yeah.
BY MS. O'LEARY:
Q And did you author a textbook called Environmental Modeling and Health Risk Analysis?
A Yes. It has my name on it.
Q And if you could go on Government Exhibit 6 to the page -- it should say 17?
A Uh-huh.
Q Okay. In the bottom paragraph on page 17, could you read that paragraph, Professor Aral?

A "On the other hand, there are at least three reservations one should always bear in mind while constructing and using a model (Rubinstein -- Rubinstein 1981). First, there's no guarantee that the time and effort devoted to modeling will return useful results and satisfactory benefits. Occasional failures are expected to occur because of limited resources allocated to modeling. More often, however, failure results when the investigators relies too much on the method and not on the ingenuity and construct of the -- construction -- constructing the model. The proper balance between the two is the key to success in modeling.

"The second reservation concerns the tendency of the investigator to treat his or her mathematical description of the problem as the best representation of the reality. One should be open minded in understanding the limitations of the proposed model."

"The third reservation concerns the use of model outside the predictive range of the model developed. When working with a model, care must be given to ensure that the analysis remains within the valid representation range of the model. These are

important concepts of concern when working with a model -- with models."

Q And Professor Aral, did you write that paragraph that you just read?

A Yeah.

Q Do you --

A Yes.

Q -- agree with it still?

A Yes.

Q Okay. When it said "the use of the model outside the predictive range of the model developed is a reservation in modeling," why is that?

So why is it that the use of the model outside the predictive range of the model development should be considered?

A Okay.

MR. DEAN: Object to form.

A When someone develops a model, it involves some approximation of the environment. If the construct of the model does not include all the important aspects of the modeling aspects of the environment, then some of the processes that exist in the environment may not -- may not be represented in the model. That's a problem. That's what I'm referring to there.

BY MS. O'LEARY:
Q Okay. And in that paragraph when it refers to the predictive range of the model, what is the predictive range of the model?
MR. DEAN: Object to the form.
A Predictive range is what I have described. For example -- just to give you an example, if you are working with surface water models, if you exclude advective transport and use only diffusive transport, than the predictive range is defined wrong.
The main transport parameter in a surface water model is the advective range. So if you -- if your model construct is wrong, its predictive range is limited.
BY MS. O'LEARY:
Q Okay. How do you determine the predictive range of a model?
A You have to understand what's going on in the environment as the major contributors to what you are trying to model.
Q Okay. And what does it mean to have the valid representation range of the model?
A As I have explained a minute ago, all the dominant characteristics of the environment should

be represented for the model to be successful.

Q How do you determine what the dominant characteristics are?

A You have to understand the environmental processes that you are modeling.

Q And how do you determine which environmental processes you are modeling?

A You have to understand the environmental processes that you are working with.

Q Okay. How -- with that understanding of the environmental processes you are working with, how do you determine what representation range would be valid for a model of those processes?

A As I have said a minute ago, if you exclude the dominant processes from a model, it will not be a successful model.

As I have described in surface water modeling, if you ignore advective transport and only include diffusive transport, that's not going to be a successful model.

Q Staying on the same exhibit, could you go to page 18, which is the next page?

A Page what?

MR. DEAN: Eighteen.

BY MS. O'LEARY:

Q Page 18, just the next page?

A Okay.

Q And the bottom paragraph on page 18 that starts, "Model accuracy and reliability," do you see that?

A Yes.

Q Could you read that paragraph, please?

A "Model accuracy and reliability are two of the more important aspects of modeling which should not be overlooked if a model is to be accepted as a reliable predictive tool numerical error bounds generated in computation should be within acceptable limits and the model should be calibrated regionally or locally using available data. Proceeding in the -- in this direction much of the recent work done in environmental quality modeling has been -- has been oriented towards improving models and incorporating better numerical solution techniques, the accuracy of which by far surpasses the availability and accuracy of the field parameter data that have to be used with such models. Scarcity of the field data, especially in air, groundwater, surface water quality modeling is well known to researchers and engineers working in

this field.

"Currently, there is some disagreement among researchers as to whether higher priority should be placed on still further developments and model sophistication or on parameter prediction to improve accuracy."

Q And do you agree with this paragraph still today?

A What does it say?

Q Do you agree with --

A Oh, yeah.

Q -- what it says today?

A Yes, I do.

Q Okay. And how do you determine acceptable limits for numerical error bounds?

MR. DEAN: Object to the form.

A Well, I'm trying to say in here is that as the computers or the field of computer applications advanced, we are using more, faster, and higher precision computers. Using that base, we are able to come up with more sophisticated numerical algorithms to predict the behavior of a -- or calculate the behavior of a model in a more precise manner.

What I am trying to say here is that

there should be a balance between computational aspects as opposed to model construct.

BY MS. O'LEARY:

Q And when you say a balance, a balance in what? In terms of sophistication or something else?

A The balance is in reference to how we represent the environment, computational aspects refers to how we compute the mathematics of the algorithms that we have proposed.

Q Okay. And what does it mean to calibrate a model regionally?

A Well, you use the data available at the site and either manually or statistically try to adjust some of the parameters of the model that you have developed to match the observed database that you have at the site. And that's the standard calibration process.

Q And why -- why should you use available data from the site as opposed to, like, a literature reference?

A Well, both can be used.

Q Okay. So in -- in page 18, it -- it says using field parameter data.

A Yeah.

Q Is that right?
A Yeah.
Q Why -- why reference field parameter data?
A Because we are trying to fee- -- represent some environment at the field. We have -- if you are developing a model for that field, we would like to use field parameters.
Q Okay. What does it mean to calibrate a model locally?
A Oh, this -- this is a matter of dimensions. You can calibrate a regional aquifer, like Floridan aquifer, which includes the aquifer system in Georgia and Florida --
Q Okay.
A -- as USGS is doing or I would call a local analysis, like Camp Lejeune application, which is relatively small in reference to a Floridan aquifer.
Q Okay. And similarly to regional calibration, why would you use --
A Can you speak, please, louder?
Q Yes.
So why would you use available field data for calibrating a model locally?

A For the same reason as we would use a regional model -- to calibrate a regional model.
Q Okay. Staying on this same exhibit, if you can be on page 19, so where the --
A Uh-huh.
Q -- last paragraph ended, can you read the next paragraph that starts, "A very simplistic model"?
A The whole paragraph I should read?
Q No. Actually, just -- I'll -- I'll -- do you mind if I just stop you when I need you to stop?
A Okay.
Q Okay. Go ahead.
So if you could start reading and I'll just ask you to stop.
A I see. Okay.
"A very simplistic model may use a very crude -- crude definition of a physical process with few parameters to define the process. A very complex model may use a very detailed definition of a physical process, which is a significant increase in -- with a significant increase in parameters that is used to define the process.
"Naturally, improved sophistication of the models is associated with the increase and the

number of model parameters. Since it's likely that many of the additional parameters included in the model will be defined only in qualitative terms or with lesser accuracy, a relatively more sophisticated model can be less reliable than the simpler version. On the other hand, some systems and some physical phenomenon are so complex in nature that it's often little reason to believe that good simulations are possible with simplified representations."

Q And you can stop there --

A Okay.

Q -- Professor Aral. Thank you.

And do you agree with the portion of that paragraph you've just read?

A Yes.

Q And how would parameters defined only in qualitative terms or with lesser accuracy lead to a less-reliable sophisticated model relative to a simpler one?

MR. DEAN: Object to the form of the question.

A Can you repeat that so that I can understand what you are --

BY MS. O'LEARY:
Q Would you like me to rephrase?
A Yes. Rephrase, please.
Q So Professor Aral, the paragraph said that when parameters are defined only in qualitative terms or with lesser accuracy, this can lead to situations where a sophisticated model is less reliable than a simpler one.
Do you agree?
MR. DEAN: Object to the form of the question.
A Well --
MR. DEAN: It mischaracterizes --
THE WITNESS: Yeah.
MR. DEAN: -- misstates --
A I'm assuming here is that a complex model is going to need more database to implement the model. If we are talking about more database, some of those databases may not be available and can be only determined through some qualitative analysis of what we know about the database.
In that case, the -- the database being qualitative may result in model response not being as accurate as we would like to see.

BY MS. O'LEARY:

Q So in those situations where you don't have the databases for some parameters, is that where a simpler model could be more reliable than a sophisticated model?

MR. DEAN: Object to the form of the question.

A If there's no database available, yes, that would be a better idea.

BY MS. O'LEARY:

Q What if you had sophisticated models where you had some databases for parameters but very few, could that still lead to situations where the sophisticated model that needs that, you know, small bit of information available is less reliable than a simpler model?

MR. DEAN: Object to the form.

A No, I don't think so.

BY MS. O'LEARY:

Q Why not?

A Because a complex model can be used with partial databases available at the site. And then there are other databases, if needed, can be associated with the database that you are using, characterization of the site --

Q Uh-huh.
A -- and other information that you have at the site.
Q So that would allow you to run the sophisticated model --
A Yeah.
Q -- is that right?
A Yeah.
Q But how do you know it's more reliable than a less sophisticated model?
A Oh, it is reliable because we are representing the environment in a better form. In other words, as I said earlier, if you omit dominant features of an environmental process, your model will become simple but, at the same time, much more uncertain or inaccurate.
Q Okay. Another portion of what you read said that, "On the other hand, some systems and some physical phenomena are so complex in nature that there is often little reason to believe that good simulations are possible with simplified representations."
And my --
A Yeah.
Q -- question is: How do you determine

whether physical phenomena are so complex that good simulations are unlikely?
A Well, you have to have experience in the environmental analysis and modeling techniques.
Q But specifically, how would you approach those techniques to determine when physical phenomena are so complex that a good simulation --
A You should --
Q -- is unlikely?
A -- you need to have an education in that field to understand what you are doing and what you are doing properly.
Q And is there agreement in the field on when it is that physical phenomena are so complex that good simulations are unlikely?
A Mostly, yes.
Q You said "mostly."
Where is there --
A Some people --
Q -- remaining disagreement?
A -- may not understand the environmental processes properly so they may end up using simpler models. That will be a problem.
Q But I mean, you agree then there are some times when physical phenomena are so complex that a

good simulation is unlikely?
A Please --
MR. DEAN: Object to the form of the question.
A -- speak louder.
BY MS. O'LEARY:
Q Yeah.
This exhibit says that "physical phenomena can be so complex that good simulations are unlikely."
Do you agree?
MR. DEAN: Object to the --
MS. BAUGHMAN: Object to the --
A I don't understand the relevance of the question in reference to the Camp Lejeune modeling.
BY MS. O'LEARY:
Q So right now my question is just about what this textbook says.
A Okay.
Q So the -- where it says, "On the other hand, some systems and some physical phenomena are so complex in nature, that there is often little reason to believe that good simulations are possible with simplified representations," that section; do you agree that that's true?

A That's true.
Q Okay. And then I think we are going to jump forward on this exhibit.
A Uh-huh.
Q -- to -- there's a page 56.
(Whereupon, there was a discussion off the record.)
A Fifty-six. Oops.
Yeah. Okay.
BY MS. O'LEARY:
Q And there's a figure and then a paragraph below that, that starts, "The uncertainty and errors."
Do you see that?
A Yes.
Q Would you mind reading that paragraph, please?
A "The uncertainties and errors in simulation may arise from uncertainty in model inputs or parameters, i.e., parametric -- parametric or data uncertainty. When a model application involves both model and data uncertainties, it's important to identify the relative magnitudes of the uncertainties associated with the data and model formulation."

Q And you can -- sorry. Go ahead.
A "Such a comparison is useful for focusing resources where they are most appropriate, data gaps versus model refinement."
Q Thank you, Professor Aral.
And why is it important to identify the relative magnitudes of the uncertainties associated with data and model formulation?
A Because the model itself uses some database from some field and the effects of the uncertainty on the database need to be characterized through some analysis. That is what is uncertainty analysis is.
Q But why -- why do they need to be characterized?
A Because we would like to understand whether the model is behaving properly in reference to the uncertainty that exists at the database.
Q So does that make it important to the model's reliability?
A Model's -- model reliability is a different subject. Uncertainty analysis is a different subject.
Q Okay. I'm not sure I understand then what the uncertainty -- why identifying the relative

magnitude of uncertainties is important.

MR. DEAN: Object to the form of the question.

BY MS. O'LEARY:

Q Why --

MR. DEAN: You need to ask a question.

BY MS. O'LEARY:

Q Why is it that it's important to know the relative magnitude of uncertainties?

A Right. Because it refers to the uncertainty on the database. If there's uncertainty on the database, the model response will give us a range of error bounds.

Q Uh-huh.

A So the model's behavior can be characterized to see whether it's working in -- within that model uncertainty band -- band that we have developed in terms of uncertainty analysis.

Q Okay. You can set aside that exhibit. Thank you.

MS. O'LEARY: And can we pull 23?

(Whereupon, there was a discussion off the record.)

BY MS. O'LEARY:
Q Actually, we will move on, actually, to some questions, more specifically, about the ATSDR water modeling at Tarawa Terrace.
A Okay.
Q So could you --
A Are we --
Q -- go back --
A -- skipping this?
Q We're skipping that one for right now, yeah.
A Okay.
Q Could you go back to -- could you go back to Exhibit 3, please, Government Exhibit 3?
It should be the -- I think it's in that stack, actually --
A Excuse me.
Q -- Professor Aral.
A It's --
Q Oh, it's there?
A Yeah.
Q Okay. Perfect. Thank you.
MR. DEAN: Can you tell me what Exhibit 3 was? Was it A -- chapter A or --

MS. O'LEARY: Chapter A for Tarawa Terrace.

MR. DEAN: Okay.

A Yes.

BY MS. O'LEARY:

Q Okay. So Professor Aral, can you go to one of the early pages on this report. This will be page iii, so little Roman numeral iii.

A Three. Yeah. Okay.

Forward.

Q Yeah. It should say, "The Forward."

And can you read the first paragraph, please?

A "The Agency for Toxic Substances and Disease Registry, ATSDR, an agency of the U.S. Department of Health and Human Services, is conducting an epidemiologic study to evaluate whether the -- whether in utero an infant up to one year of age exposure to volatile organic compounds in contaminated drinking water at U.S. Marine Corps Base Camp -- Base Camp Lejeune, North Carolina, were associated with specific birth defects and childhood cancers.

"The study includes births occurring during the period 1968 to 1985 to women who were

pregnant while they resided in family housing at the base. During 2004 -- or -- at the base.

"During 2004, the study protocol received approval from the Centers for Disease Control and Prevention Institutional Review Board and the U.S. Office of Management and Budget."

Q And -- so Professor Aral, when you were working on the Tarawa Terra- -- Terrace water modeling with the ATSDR, were you aware that the ATSDR was conducting an epidemiological study to evaluate whether in utero and infant exposures to VOCs in contaminated drinking water at Camp Lejeune were associated with childhood cancers?

A I heard that in expert panels and so forth.

Q And were you aware of the time frame of that study of 1968 to 1985?

A Yes, I'm aware of that.

Q Okay. And then the next paragraph says, "Historical exposure data needed for the epidemiological case control study are limited. To obtain estimates of historical exposure, ATSDR is using water modeling techniques and the process of historical reconstruction. These methods are used to quantify concentrations of particular

contaminants in finished water and to compute the level and duration of human exposure to contaminated drinking water."

Did I read that correctly?

A Yeah. That's correct.

Q When you were working on the Tarawa Terrace water modeling, were you aware that the modeling work you were doing was intended for this epidemiological study?

A Yes.

Q And were you aware that it was not intended for estimating an individual's exposure?

MR. DEAN: Object to the form of the question.

A I -- I am -- I don't have any idea on that --

BY MS. O'LEARY:

Q Okay.

A -- question.

Q When you were working on the Tarawa Terrace water modeling, were you aware that the modeling work you were doing was not intended to be used so that a particular individual could determine whether an estimated exposure from the model caused his or her health condition?

A I can't --

MR. DEAN: Object --

A -- answer that.

MR. DEAN: Let me -- let me object to the form of the question, please.

BY MS. O'LEARY:

Q Why can't you answer that?

A Because that's a "epi" topic that I'm familiar with --

(Whereupon, the court reporter requests clarification.)

A "Epi," epidemiologics.

BY MS. O'LEARY:

Q So are you saying you don't know?

A What it is going to be used for --

Q You --

A -- I don't know what the models are going to be used for. Is -- is it for a public exposure? Individual exposure? Community exposure? I have no idea.

Q So when I look at page iii on this Exhibit, the Tarawa Terrace chapter A, it looks like it's saying the historical exposure data were needed for the epidemiological case control study.

MR. DEAN: Object to the form.

BY MS. O'LEARY:

Q Am I understanding that correctly?

MR. DEAN: Object to the form of the question. Mischaracterizes --

A That's --

MR. DEAN: You are not reading the paragraph -- the paragrapher correctly.

A Well, that's what ATSDR, as a whole within different units, are going to investigate that, but that has nothing to do with what I'm doing.

BY MS. O'LEARY:

Q But you are listed as an author of chapter A; correct?

A I am not an author on the "epi" study. I am on the -- on the author -- I am the author on the modeling aspects of this. So this is probably a group of people doing different work, different fields and using each other's inputs, outputs.

Q Okay. Professor Aral, can we go to your report again?

A Yes.

Q And this is Exhibit 2, Government --

A Yeah.

Q -- Exhibit 2.

Give me just a minute while I try to find the page I want you to turn to.
All right. If you could go to pages four to five of your report?
A My expert report?
Q Of your report, yes.
MR. DEAN: Uh-huh.
A Yes.
MR. DEAN: What page? I'm sorry.
MS. O'LEARY: I had said four to five.
MR. DEAN: Okay.
MS. O'LEARY: But we may be moving.
Oh, excuse me. Page 12.
THE WITNESS: Okay.
BY MS. O'LEARY:
Q And, Professor Aral, this is in a section called, "Principles of water modeling and application at Camp Lejeune," and subsection 4.1 "Water Modeling."
Do you see the sections?
And then --
A Yeah.
Q Okay. There's a -- it says -- in the middle of the page, it says, "My opinions within a

reasonable degree of scientific and engineering certainty on modeling techniques, their principles and their application to the Camp Lejeune site include the following," and then there's a list of -- a bulleted list.

Do you see that?

A Yes.

Q Okay. So the second to the last bullet from the bottom says, "The models and techniques used by the ATSDR for historical reconstruction, including fundamental equations, input parameters, parameter estimates, calibration uncertainty and sensitivity analyses were and remain reliable, scientifically valid and state of the art procedures that are consistent with standard practices used and are generally accepted in this field."

Do you agree with that statement still?

A Yes.

Q Okay. And -- and then if you go onto page 13, the last bullet, do you see where I'm looking at?

A Yeah.

Q It says, "The analyses published in all ATSDR chapter reports, ATSDR 2007 and ATSDR 2013, and supplemental information regarding Camp Lejeune,

see figure two, including the conclusions and monthly concentration data, were all done applying proper scientific and engineering methodologies and remain to this day to be mathematically reliable, statistically, accurate and correct."

Did I read that properly?

A Yes.

Q Do you agree with that?

A Yes.

Q Okay. So if you are saying that the analyses -- analyses published in all ATSDR chapter reports and supplemental information on Camp Lejeune were done applying proper scientific and engineering methodologies and remain to this day to be mathematically reliable, statistically accurate and correct, then if we come back to my questions about the forward in the ATSDR chapter A report --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q Yes.

-- the chapter A report for Tarawa Terrace --

MS. BOLTON: Exhibit 3.

MS. O'LEARY: Yes, Exhibit 3.

A Uh-huh.
BY MS. O'LEARY:
Q -- I mean, aren't you saying that this isn't correct?
MR. DEAN: Object to the form. I'm not sure what the question is.
A As far as I understand the question, what I am referring to in my expert report refers to modeling aspects of the environment that we are trying to model, they are accurate, scientifically correct, mathematically correct, statistically correct.
But this paragraph that you are referring to is associated with the use of these outcomes in "epi" studies. That is outside my expertise area.
Probably ATSDR is correct in putting that paragraph in there but that's not my expertise area. Is -- I am only a contributor to this chapter, not the author of this chapter.
BY MS. O'LEARY:
Q Okay. So the limit on your statement about the -- that we just read from your report -- is -- is limited to the -- the modeling aspects of --
A Exactly.

Q -- the ATSDR reports?
Okay.
A Exactly.
Q If you can stay in the chapter A report and go to page 90 -- A 98, is how it's labeled.
A A 90?
MR. DEAN: Ninety-eight.
BY MS. O'LEARY:
Q Ninety-eight.
A Ninety-eight.
Yes.
Q Okay. So Professor Aral, there are two columns; do you see that?
A Yeah.
Q The column on the left, the bottom question, it starts "ATSDR's historical reconstruction analysis."
Do you see that?
A Yeah.
Q All right. In the paragraph that's to the right of that, so in the other column, do you see where it says "ATSDR's exposure assessment cannot be used to determine whether you or your family suffered any health effects as a result of past exposure to PCE contaminated drinking water at

Camp Lejeune. The study will help determine if there is an association between certain birth detects and childhood cancers among children whose mothers used this water during pregnancy. Epidemiological studies such as this help improve scientific knowledge of the health effects of these chemicals."

Did I read that correctly?

A Yes.

Q Do you agree?

A It's outside my expertise area.

Q Okay. And staying in this same report but flipping back to page A67?

A Yes.

Q And there's a -- two columns. The one on the right says, "Summary and Conclusions."

A Yeah.

Q Do you see that column?

A Yeah.

Q The first paragraph there begins, "Two of the three drinking water systems that served family housing at U.S. Marine Base Camp Lejeune were groundwater with VOCs. Groundwater was the sole source of drinking water supply. One system, the Tarawa Terrace drinking water system, was mostly

contaminated with PCE when water supply wells were contaminated by off-base dry cleaning operations at ABC One-Hour Cleaners." And then it cites Shriver, 1985.

Did I read that correctly?

A Yes.

Q Do you agree that the Tarawa Terrace drinking water system was mostly contaminated with PCE?

A That's -- that's correct.

Q And I apologize for jumping around within this exhibit --

A That's okay.

Q -- but can you go back to page A1, please, and going onto page A2, which is farther from the beginning than you might think. The Roman numerals go on for a little ways.

A Okay.

Q You should be on a page that says "Abstract," on the left.

Do you see that?

A A2?

Q A1, going --

A A1.

Q -- into A2.

A Okay.

Yes.

Q Okay. So the -- the column on the right, the last paragraph that starts, "Models and methods."

Do you see that?

A Yes.

Q So it says, "Models and methods used as part of the historical reconstruction process for Tarawa Terrace and vicinity included one, MODFLOW-6 used for simulating steady state, predevelopment, and transient groundwater flow; two, MT3DMS, used for simulating three-dimensional single-specie contaminant fate and transport; three, a materials mass balance model simple mixing used to compute the flow-weighted average concentration of PCE assigned to the finished water at the Tarawa Terrace Water Treatment Plant, WTP; four, TechFlowMP used for simulating three-dimensional multispecies, multiphase mass transport; five, PS Ops used for simulating the impacts of unknown and uncertain historical well operations; six, Monte Carlo simulation and sequential Gaussian simulation used to conduct probabilistic analyses to assess uncertainty and variability of concentrations of

PCE-contaminated groundwater and drinking water; and seven, EPANET 2, used to conduct extended period hydraulic and water quality simulations on the Tarawa Terrace water distribution system."

Did I read that correctly?

A Yes.

Q Am I understanding this correctly that the ATSDR -- that this is describing ATSDR's process for historical reconstruction of contaminants at Tarawa Terrace?

A I think it describes the models used in that process.

Q In that process, okay.

Oh, sure distinguished as from, like, data collection or --

A Yeah.

Q -- other aspects?

A Different aspects are different.

Q Yeah. Okay. I understand.

But in terms of the modeling, am I understanding correctly that at Tarawa Terrace, ATSDR's historical reconstruction process for modeling did not include simulating historical benzene concentrations at Tarawa Terrace?

A TechFlowMP can model PCE -- oh, this is

in reference to Tarawa Terrace, right?
Q Right.
A Okay.
Q At Tarawa Terrace.
A Right. Of course.
We didn't use -- we didn't analyze benzene at Tarawa Terrace.
Q Okay. And would you agree that in your report you have not offered opinions about simulated historical benzene concentrations at Tarawa Terrace?
A We did not simulate that.
Q And so you -- is that why you didn't offer any in your report?
A Well, can you repeat that question?
Q Yeah. Let me rephrase.
So your report in this litigation, it also does not offer opinions on historical benzene contamination levels at Tarawa Terrace.
A It --
Q Is that right?
A It -- we did not simulate benzene concentrations at Tarawa Terrace.
Q Okay. Staying in the Tarawa Terrace chapter A report, could you go to page A17, please?
A Okay.

Q And in the column on the left, there's a label in the middle that says, "Relation of contamination to water supply production and distribution."
Do you see that?
A Yes.
Q Okay. So within that paragraph, there's a sentence that starts, "The supply of drinking water to Tarawa Terrace."
Do you see that?
A Yes.
Q Okay. So that says, "The supply of drinking water to Tarawa Terrace was composed of two components. One, the supply of water from groundwater wells to the Tarawa Terrace Water Treatment Plant; and two, the delivery of finished water from the water treatment plant through the network of pipelines and storage tanks of the water distribution system."
Did I read that correctly?
A Yes.
Q Does that mean that the Tarawa Terrace drinking water supply, from the period that the ATSDR modeled, consisted of water supplied from groundwater wells that went to the Tarawa Terrace

Water Treatment Plant and after going through the plant they were delivered as finished water to the housing or other buildings on the Tarawa Terrace water distribution system?

A That's correct.

Q Okay. And just going onto the next page, so page A18 -- actually, sorry. If you could go onto page A19?

So one more page.

A Okay.

Q And there's a table "A6." Do you see that?

A Yes.

Q It says, "Historical operations for water-supply wells, 1952 to 1987, Tarawa Terrace and vicinity, U.S. Marine Corps Base Camp Lejeune, North Carolina."

Is this table then showing all of the water supply wells that were providing water to the Tarawa Terrace Water Treatment Plant through that 1952 to 1987 time span?

A That's the data that ATSDR presented --

Q Okay.

A -- yes.

Q So according to this table then, in the

column on the left that says "well identification," do you see the --

A Yeah.

Q -- "TT-23."

So "TT-23"?

A Yes.

Q And does -- is this table saying that that well started supplying water in August of 1984?

A Yes, I see that.

Q Okay. And then it -- it's saying that it was offline in February of 1985; is that right?

A Yes, it says that.

Q And now the same table, looking at well that's "TT-26," so TT-26?

A Yes.

Q Is the table reflecting that that well started supplying water in January of 1952?

A Yes.

Q And was offline in July and August of 1980 and January and February of 1983, is that correct?

A Yes.

Q And then the -- its service was terminated in February of 1985?

A Yes.

Q And sorry, going back up to Tarawa Terrace, TT-23 --
A Yes.
Q -- does the table reflect that service was terminated from TT-23 in May of 1985?
A Yes, it says that.
Q And if you could set aside this exhibit, Exhibit 3, for a moment.
MS. O'LEARY: And if we could get 57, this will be Government Exhibit 7.
(Whereupon, Government's Exhibit Aral 7, ATSDR's Chapter C Report for Tarawa Terrace, was marked for identification.)
THE WITNESS: Thank you.
BY MS. O'LEARY:
Q So Professor Aral, on Government -- oops, I think I handed you the wrong one. I did. I have the one with the sticker.
So let me trade you so you have the --
A Okay.
Q -- one that's marked.
So on Government Exhibit 7, do you agree this is -- looks like a copy of the ATSDR's chapter C report for Tarawa Terrace?

A Yes.
Q Okay. And if you could go to page C76, please?
A Yes.
Q Okay. And do you see a table C3.10?
A Yes.
Q And it says, "Capacity and operational history of water supply well TT-23 Tarawa Terrace, U.S. Marine Corps Base Camp Lejeune, North Carolina."
A Yes.
Q Do you agree this is the ATSDR's table showing capacity and operational well history at TT-23, which is a supply well?
A Yes.
Q And do you agree this table shows that ATSDR concluded TT-23 was out of service in February of 1985?
A I am not the author of this report so if it says that here, that's what it should be.
Q Okay. Do you see on this table in -- the date, it says -- the second to last entry, it says, "Four, 1985, service terminated."
Do you see that?
A Table six, three, ten or what?

Or what num- --

Q Table C310. So the same --

A Yeah.

Q -- table we have been looking at --

A Okay.

Q -- that's --

A Uh-huh.

Q -- the entry for -- if -- that starts, "Four --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q "Four 1985," in the date column.

MR. DEAN: Four, slash, 1985 --

MS. O'LEARY: Right.

MR. DEAN: -- next to last entry on the bottom.

BY MS. O'LEARY:

Q So we are looking at the column on the left --

A Okay.

Q -- that says date --

A Okay.

Q Yeah, the entry that starts, "4/1985."

Do you see that?

A I don't see that.
Where do you --
Q So on my copy, it's right here.
A Okay. Right there.
Okay.
Q Do you see it?
A Yeah.
Q And then -- so that's April 1985, correct?
A Yeah.
Q And it says, "Service terminated." Correct?
A Yeah.
Q Do you know why this table says TT-23 service was terminated in April of 1985, but the last table we just looked at, table A6, says TT-23 service was terminated in May of 1985?
MR. DEAN: Mis- --
A I --
MR. DEAN: I'm going to object to the form of the question. It also mischaracterizes the document.
You are also misrepresenting what the table says because in the entry just below -- above that it says, "4/30/1985,"

which is the end of the month, out of service.

So you are mischaracterizing the chart and I'd ask that you provide the witness with accurate information, please.

MS. O'LEARY: I don't see where it says "4/30" on this exhibit.

MR. DEAN: It -- it does. If you look just above the entry you just read, you didn't --

MS. O'LEARY: Oh, that one? Okay.

MR. DEAN: Oh. Yeah, that one.

A I'm not the author of this chapter so I have no comment.

BY MS. O'LEARY:

Q Okay. You mean, you don't know?

A I don't know whether it was terminated at this date or the other date or whether the other one was correct. I think the authors of the chapters should answer that question.

Q Okay. And Professor Aral, could you go back to the Tarawa Terrace chapter A report, which should be marked as Government Exhibit 3?

A Uh-huh.

Q And then go to page A27.
A Yes.
Q Okay. Do you see a table A9 on that page?
A Yes.
Q And it's labeled, "Summary of model-derived values and observed data of tetrachloroethylene at water supply wells Tarawa Terrace, U.S. Marine Base Camp Lejeune, North Carolina."
Did I read that correctly?
A Yes.
Q And the -- the data in this table, is this the sort of data you were relying on when you were building the models at Tarawa Terrace?
A Yes. This must be the data that we relied on.
Q Okay. And do you agree that table A9 purports to summarize observed and model-simulated values of PCE at the Tarawa Terrace water supply wells?
A Can you speak louder, please?
Q Yeah, I'm sorry.
Do you agree that table A9 summarizes observed and model-simulated values of PCE at the

Tarawa Terrace water supply wells?
A Unless there's a typo -- typo error, it must be the correct numbers.
Q Okay. And do you agree that according to this table, between -- between January of 1952, so the earliest date on this table --
A Uh-huh.
Q -- and December of 1987, PCE was detected in only Tarawa Terrace 26. So TT-26, TT-23 and TT-25.
So looking at the column on, "Observed data for PCE concentration."
A Uh-huh.
Q So --
A Yes, I see that.
Q All right.
MS. BAUGHMAN: I'm going to object to the form. That's not correct.
BY MS. O'LEARY:
Q And so if we start with the section on supply well TT-23, you agree there are detections of PCE in TT-23?
A Yes, I saw that.
Q And do you agree that the highest PCE detection on the table was 132 micrograms per liter,

and that's from January 16, 1985.
Is that correct?
A That's correct.
Q And do you agree that for TT-23, there were non-detections, meaning no PCE detected, in February of 1985, in April of 1985, and July of 1991?
MR. DEAN: Object to the form.
A Yes, I see that here.
BY MS. O'LEARY:
Q Okay. And looking at the -- the next supply well, so supply well TT-25, the next section.
A Uh-huh. Yes.
Q Do you agree that the only PCE detection in -- detections in TT-25 were 0.43 micrograms per liter in September of 1985, and 23 micrograms per liter in July of 1991?
A Yes, I see that.
Q Do you know what the "J" means next to the "0.43"?
A "J"?
Q Yeah. If you look at the entry for September 1985 for supply well TT-25, the PCE concentrations says, "0.43 J."
A I didn't notice that even.

Q Okay.
A I don't know what it means.
Q Okay. And do you agree that at supply well TT-25, there were non-detections of PCE in February, in April of 1985, as well as October, November, and December of 1985?
MR. DEAN: Object to the form.
A I see that.
BY MS. O'LEARY:
Q Okay. And at -- if we go down to supply well TT-30, TT-31, TT-52, TT-54, TT-67, and RW1, there are only non-detections of PCE listed.
Is that correct?
A I see that, yes.
Q But then for supply well RW2, there is a detection.
A I see that, yes.
Q And that's in 1991?
A Yeah.
Q And then at supply well RW3, only a non-detection.
A Yes.
Q Okay. Could you go, in the same report, so still Tarawa Terrace chapter eight, to page 40 of this?

And the page A40, it should say -- the label should say, "Concentration of tetrachloroethylene, PCE, in finished water."

A Yes.

Q Do you see that?

All right. In the first paragraph on the left column that starts, figure A18 -- do you see where I am?

A Yes, I see that.

Q All right. The next sentence -- no, not the next one.

About --

A "A monthly listing of..." --

Q Just a second.

All right. Near the bottom of that first paragraph --

A Uh-huh.

Q -- there's a line that starts with a number, "1.3 micrograms per liter."

Do you see that?

A Yes.

Q Okay. Right next to that, there's a sentence that starts, "The PCE concentration of finished water at the Tarawa Terrace Water Treatment Plant is less than the PCE concentration of water

supply well TT-26 because the mixing model uses water supplied to the water treatment plant from all wells, contaminated and uncontaminated."

Do you see that?

A That's correct.

Q And do you agree that the PCE concentration in water distributed from the Tarawa Terrace Water Treatment Plant had lower PCE concentrations than in TT-26?

A We can look at the data. If that's the case, that might be.

Q I mean --

A Yeah.

Q -- do you agree with what the document says?

A That's what the document says, yes.

Q Okay. Do you have any reason to think that's not true?

A No, I don't have any reason to think that's not true.

Q Okay. And then in the same paragraph, still on page A40 --

A Yes.

Q -- but a little farther up, there's a line that starts -- it's the one, two, three, four,

five -- the seventh line down that's -- on the left the first word is, "Period."

A Okay.

Q Okay. At the end of that row, there's a sentence that says, "PCE contamination of water supply well TT-26 was the primary contributor to contamination in the finished water of the water treatment plant."

Do you agree that TT-26 was the primary contributor of PCE contamination to Tarawa Terrace Water Treatment Plant?

A Yes, I do.

Q And do you agree -- looking back at table A6, which is on page A19, that according to the ATSDR --

MR. DEAN: Give him time to get there, if you don't mind?

MS. O'LEARY: Sure.

BY MS. O'LEARY:

Q So this was A19.

A Uh-huh.

Q Okay. Do you agree that this shows that TT-26 had its service terminated in February of 1985?

A Which table are we looking at?

Q A6.
A A6. Okay.
Q So in the --
A Yeah.
Q Don't --
Service terminated TT-26, February 1985; you agree?
A Yup.
Q Okay. So if TT-26 was the primary contributor of PCE to the Tarawa Terrace Water Treatment Plant and it shut down in February of 1985 --
A Uh-huh.
Q -- do you agree that after that happened, PCE concentrations at Tarawa Terrace Water Treatment Plant would have significantly decreased?
A Would have decreased, yes. Significantly or not it depends on the contributions of the other wells.
Q Well, if it's the primary contributor --
A Yeah, of course.
Q -- doesn't that make it significant decreases?
MR. DEAN: Object to form.
A I don't think so.

BY MS. O'LEARY:
Q Why not?
A Because the contribution is not only coming from TT-26 --
Q Uh-huh.
A -- but other wells as well.
We have to go back and look at all the other contaminant concentrations in all the other wells to see whether it's significant or not.
Q Sure. So if we go to table A9 again, which was on page A27 --
A Twenty-seven.
Okay.
Q And -- and I think we went through this earlier, but the highest detection of PCE at TT-23 was 132 micrograms per liter.
And at TT-25, the highest detection before 1987 was 0.43 micrograms per liter. And there were no detections in any other wells before 1987 --
A Uh-huh.
Q -- is that correct?
And then if we look at --
MR. DEAN: You didn't read, with all due respect, or for the record, that this

is "0.43 J."

And 0.43 J, the "J" means estimated.

THE WITNESS: Okay.

MS. O'LEARY: I don't -- I don't know that that's accurate.

BY MS. O'LEARY:

Q But if we look then at supply well TT-26, the highest concentration there, it looks like it's 1,580 micrograms per liter. So almost -- more than ten times higher than the next highest concentration in a well.

Do you agree?

A Which one are you referring to?

Q I'm on page A27, table A9?

A Yes.

Q All right. So --

A Okay.

Q So if we look at TT-26 --

A Yes.

Q -- its highest concentration measured is the 1,580 --

A That's correct.

Q -- micrograms per liter, and that's more than ten times higher than the 132 micrograms per liter, that's the highest measured concentration in

another supply well before 1987.
Do you see that?
A Which well are you comparing this 1580 number with?
Q All of the other wells.
A Can you speak louder, please?
Q Yeah. All the other wells.
But the specific --
A All the other wells?
Q Yeah.
A Combined?
Q No, not combined.
Individually.
A Individually, they are less than 1580.
Q I mean, more than ten times less than 1580, right?
A Yeah.
Q Okay. And if you could go to page A18 --
MR. DEAN: For the record, on page A27, at the top in the definitions, under the table A9, in parentheses, it gives a definition of the "J."
It says, "Estimated."
BY MS. O'LEARY:
Q And Professor Aral, are you on page A18?

A Yes.
Q Okay. And there's a large figure that covers most of the page. The text at the bottom is where --
A Okay.
Q -- I'd like to direct your attention.
The column on the left, there's a sentence that begins, "Once a well was put in service." It's the third line from the bottom.
Do you see that?
A Yes.
Q Okay. So that says, "Once a well was put in service, it was assumed to operate continuously for modeling purposes until it was permanently taken offline, the exception being temporary shutdowns for longterm maintenance. Breaks in continuous operation, such as those for wells TT-26 and TT-53, are also shown on figure A5 and are based on documented information detailing periods of maintenance for a specific wells."
Did I read that correctly?
A You read that correctly.
Q Is it true that in the ATSDR model, Tarawa Terrace supply wells were modeled such that they are assumed to operate continuously unless

there was documentation that they had been temporarily shut down for maintenance?
A That's correct.
Q And if you could go onto page A20 of the Tarawa Terrace report?
Can you go onto page --
A A what?
Q A20.
Just one -- two pages forward.
A Okay.
Yes.
Q And there's a figure A6 on the bottom. Do you see that?
A Yes.
Q Okay. It's labeled, "Total annual groundwater pumpage at water supply wells, 1952 to 1987, Tarawa Terrace and vicinity, U.S. Marine Corps Base Camp Lejeune, North Carolina."
And --
A You have to speak sl- --
Q Yeah.
On this table --
A Yeah.
Q -- A6, is -- is this showing -- I guess my first question is: What is pumpage of a water

supply well?

A The amount of water contributed to water treatment plant.

Q Okay. So is table A6 showing the amount of water that the -- at the Tarawa Terrace Water Treatment Plant that the ATSDR model had coming from each well at each year?

A At each year at each --

Q For each --

A -- pumping --

Q -- well?

A Yeah, okay.

Yes.

Q Okay. And do you agree that in looking at A6, TT-26 and TT-23 are not modeled as contributing any water to the Tarawa Terrace Water Treatment Plant in 1986 and 1987?

A That's right.

Q Okay. And so the wells where contamination was detected before 1987, we had TT-26, TT-23, and TT-25.

Is that correct?

A Uh-huh. Yes.

Q Okay. So according to figure A6, for 1986 and 1987, the only well that the ATSDR's Tarawa

Terrace model of those three that was still pumping was TT-25.
Is that right?
A Repeat that question, please?
Q Yeah. So on figure A6, for just the last two years, 1986 and 1987 --
A Yes.
Q -- of -- of the three wells where contamination was found before 1987, the only one that the ATSDR model had as contributing water to the Tarawa Terrace Water Treatment Plant in '86 and '87, was TT-25.
Is that correct?
A TT-25?
TT-25, yes. It's contributing, according to this figure, yes.
Q But TT-26 and TT-23 are not --
A Are not.
Q -- correct?
A Yes.
Q Okay. And TT-25 was the well that had the only detection before 1987 of PCE was 0.43 micrograms per liter with the "J"?
A Yes.
Q Still in Tarawa Terrace chapter A, so the

same exhibit, but could you go to page A93?

A Yes.

Q All right. So this is -- says it's appendix A2.

I'll give you a minute to get to that. All right.

So we are looking at appendix A2, where it says, "Simulated tetrachloroethylene and its degradation by-products in finished water, Tarawa Terrace Water Treatment Plant, January 1951 to March 1987, continued."

So is this the simulated P- -- or contaminant concentration levels from the ATSDR's Tarawa Terrace model?

A It has -- this -- this table includes the MT3DMS results as -- also, TechFlowMP results.

Q Okay. But both of those aren't, like -- those are the simulated concentrations from the Tarawa Terrace water model; is that correct?

A That's correct.

Q All right. So if I -- the column on the left is called "Stress periods." And I want to look at the -- the last two. So four, 30 -- well, actually, not quite the last -- the last three. 433 and 434, that say they are January 1987 and

February 1987.
Do you see that?
A Yes.
Q And do you agree on the MT3D model, those show PCE concentrations of 17.85 micrograms per liter and 18.49 micrograms per liter?
A Yes.
Q And on the TechFlowMP version, it shows 8.28 micrograms per liter and 8.71 micrograms per liter of PCE.
A Yes.
Q Okay. And these levels in appendix A2, that's at the water treatment plant; correct? That's all of the wells' contributions, combined?
A Yes.
Q So the only well contributing in this simulation where there was a detection of PCE is TT-25, right?
A According to the earlier pumpage records.
Q Okay.
A TT-25 --
Q Yeah.
A -- is there, TT-28 is there, TT-54 is there --
Q Uh-huh.

A -- and TT-27 is there. That's what I see.
Q Okay. And -- but of those wells, it was only TT-25 that had a detection of PCE?
A In terms of site observations --
Q Right.
A -- or in terms of simulated results?
Q In terms of site observations.
A That's what was on the table, yes.
Q Okay. We can set aside Tarawa Terrace chapter A for a few minutes.
A Okay.
MS. O'LEARY: If you can grab seven.
(Whereupon, Government's Exhibit Aral 8, December 2004 Report by AH Environmental Consultants, Inc., was marked for identification.)
BY MS. O'LEARY:
Q So Professor Aral, Government Exhibit 8 should be -- it looks like a report that's labeled, "ATSDR Support Estimation of VOC Removal, Marine Corps Base Camp Lejeune."
And it says the date is December 2004, and it's by AH Environmental Consultants, Inc.
Do you see that?

A Yes.
Q Have you ever seen a report from AH Environmental Consultant, Inc.'s [sic] about estimating VOC removal ATSDR -- for ATSDR before?
A I don't recall that.
Q Okay. Can you go to -- this one is numbered interestingly -- but page five, dash, one -- you know what might be easiest, do you see the -- there's little numbers at the bottom that all -- right --
A Yeah.
Q -- that start, "CLJA water modeling," yeah. Can you go to the page where the last part of that is -71486?
A Yes.
Q Okay. So this is labeled, "Summary," and it --
A Uh-huh.
Q -- says, "Where MCB Camp Lejeune is currently the subject of an epidemiological study by the ATSDR to ascertain the health impacts of certain VOCs including TCE and PCE, which were present in the Hadnot Point, Tarawa Terrace, and Holcomb Boulevard water supply systems in the early 1980s.

AH assisted in the development of referenced estimates of the VOC removal rates that might have occurred within the treatment units that existed at the three plants during 1968 to 1985."

Were you aware that AH Environmental had -- had assisted in the development of referenced estimates of VOC removal rates that might have occurred at the treatment plants?

A No, I have not.

Q Okay. And the same page, the third paragraph, it says, "The calculations revealed that VOC removal due to volatization -- volatilization from quiescent basins was negligeable at MCB Camp Lejeune. The only significant VOC removals must have occurred at the spiractor effluent pipe where the falling water undergoes some aeration. Considering the uncertainty in the estimates for the fall height over the weir formed by the pipe, the removal for TC- -- removals -- excuse me -- for TCE and PCE were likely to be less than 15 percent."

A Yes.

Q Do you agree that the date range referenced in this page, the 1968 to 1985, that corresponds to the epidemiological study that the Tarawa Terrace water modeling was supporting?

A The period of "epi" study -- yes, that's what it was.

Q Okay. And -- so do you agree that this report is saying that AH Environmental, who authored it, estimated VOC losses of TCE and PCE from spiractors at the water treatment plant would be significant, though they estimated them as less than 15 percent?

MR. DEAN: Object to the form of the question. Out -- this is not something for which this witness has opined on.

A I haven't seen this report before. I haven't seen these calculations before so I can't answer that question.

MS. O'LEARY: Okay. Can we get -- you can set this aside for a minute. And could we get 60, please?

This will be Government Exhibit 9.

(Whereupon, Government's Exhibit Aral 9, ATSDR's Chapter F, "Simulation of the Fate and Transport of Tetrachloroethylene, PCE, for Tarawa Terrace," was marked for identification.)

BY MS. O'LEARY:

Q So Professor Aral I've handed you Government Exhibit 9, that appears to be the ATSDR's chapter F, "Simulation of the Fate and Transport of Tetrachloroethylene, PCE, for Tarawa Terrace."

A Yes.

Q Do you agree that's what this exhibit --

A Yeah.

Q -- appears to be?

Okay. And can you go to page F42?

A Yes.

Q All right. Professor, in the column on the left, it says, "Level four calibration."

Do you see that?

A Yes.

Q Okay. After that, it says, "The final stage of model calibration employed a simple mixing flow-weighted average model to compute PCE concentrations delivered to the Tarawa Terrace Water Treatment Plant from all active water supply wells and, subsequently, to the Tarawa Terrace water supply network. For each stress point month of the simulation period, from January 1951 to December 1994, the PCE concentration simulated at each active water supply well is weighted by the

respective well discharge to compute a weighted-average PCE concentration. This weighted-average concentration was considered the monthly average PCE concentration delivered to the Tarawa Terrace Water Treatment Plant."

A Yes.

Q One question: When this mentions "well discharge," does that mean the water coming out of the well and going to the water treatment plant?

A Yes.

MR. DEAN: Object to the form.

A Yes.

BY MS. O'LEARY:

Q And do you agree that a -- a simple mixing flow-weighted average has no calculation where contaminants in the water coming out of a well are lost from the water supply before being distributed?

A Can you repeat that --

Q Sure.

A -- question.

Q Do you agree that a simple mixing flow-weighted average --

A Uh-huh.

Q -- calculation does not have a

calculation where contaminants in the water from wells is lost in the water treatment plant?

MR. DEAN: Object to the form.

A Where -- where does the loss come into this calculation --

MR. DEAN: That's --

A -- in your understanding? I don't understand that.

BY MS. O'LEARY:

Q I don't -- I'm not trying to suggest it does, Professor Aral. I'm trying to confirm that -- I'm understanding correctly that there is no loss calculation of contaminants in a simple mixing flow-weighted average calculation.

MR. DEAN: Object to the statement --

A At the water treatment plant?

BY MS. O'LEARY:

Q At the water treatment plant?

A Yeah. Yeah. That's what it means.

Q Okay. So you would agree that in a simple mixing flow-weighted average calculation, no -- no contaminants that enter the water treatment plant are modeled to be lost in the water treatment plant?

MR. DEAN: Object to form.
A Well, that's -- what numbers are we using to calibrate the water treatment plant database is important here. But that equation does not include contaminant losses, definitely.
BY MS. O'LEARY:
Q Okay. Would you agree that a simple mixing flow-weighted average does not have any calculation to simulate physical processes whereby contaminants could be loss in treatment?
A That's correct.
Q Okay. Professor Aral, do you agree that the ATSDR Tarawa Terrace model simulated PCE concentrations in water coming out of the water treatment plant as the same as the mixture of water entering the water treatment plant?
A It depends on the data available. If the data we have used or ATSDR has used is the treated water, that's the -- that should include the losses that is happening in the water treatment --
Q Uh-huh.
A -- plant. If not, it's just the entry concentrations.
Q My question is -- is about how the model function not about which data it was calculated to.

A The mixing model does not include any loss effects.

Q Okay. And the mixing model is what was used to simulate the water treatment plant in the ATSDR's model; is that correct?

A That's correct.

Q If we go back to Exhibit 8, which was that report from AH Environmental --

A Yes.

Q -- it's the one that had on page 5-1, but it's -- at the bottom right -- -71486.

A Yes.

Q Okay. That last paragraph, the last sentence, is where it says, "Considering the uncertainty and the estimates over the fall height from weir formed by the pipe, the removals for TCE and PCE were likely to be less than 15 percent."

Now, I understand you, you know, you haven't --

A You have to speak louder, please.

Q Sure.

So I understand you didn't -- you haven't seen this report before. I just have a -- a question about, you know, what could be done on the Tarawa Terrace model.

Could you have applied a percentage reduction to the numbers that come out of the Tarawa Terrace mixing model?

MR. DEAN: Object to the form of the --

A Arbitrarily?

MR. DEAN: -- question.

BY MS. O'LEARY:

Q Well, no. Not arbitrarily --

A I mean --

Q -- but -- but could you -- I mean, just as a calculation, could that have been done?

A Right.

MR. DEAN: Object to the form.

A We -- we wouldn't do that.

BY MS. O'LEARY:

Q What do you mean?

A We wouldn't --

Q Who is "we"?

A We wouldn't apply a certain percentage of loss, in quotes, arbitrarily to any computation of our environment.

Q I -- I understand that. I don't mean to suggest you would.

My -- my question is though, like, if the

ATSDR had, you know, told you that they estimated treatment losses at a certain percentage, could you have applied that percentage to reduce the simulated values?
A We wouldn't do that.
Q Why not?
A Because we have to compute something that we use. It's that -- simple as that.
Q What do you mean you have to compute something you use?
A If there's a certain loss in a process --
Q Uh-huh.
A -- we have to model that, understand that process, and that process gives us a certain percentage of loss. And then we can use that number as the outcome of treatment at water --
Q Okay.
A -- treatment plant.
Q So if someone else had calc- -- had calculated what that would be, you could have used it?
A In ATSDR calculations on Camp Lejeune, we never relied on somebody else's calculations, we relied on our calculations.
Q Right.

A You just said --
Q Well, I'm --
A -- if somebody else --
Q Uh-huh.
A -- has calculated something, wouldn't you have used it?
My answer is no.
Q But couldn't someone -- some other part of ATSDR other than MESL have done that and given it to you to --
A If --
Q -- use?
A If they had done an analysis of that, yes, of course.
Q Okay. And would you expect to see gains in contaminant concentrations going through a water treatment plant?
A That's very unusual.
Q Why is that very unusual?
A If you treat some chemical through a treatment plant, it's supposed to reduce the concentration.
Q Okay. And Professor Aral, would you like to take a -- a break or would you like to keep going?

A I'm okay.

Q Okay.

MS. BAUGHMAN: I think we are having lunch at noon so you want to keep going for 20 minutes?

MS. O'LEARY: Sure.

MS. HORAN: Can we just take a two-minute break for water and then can take a break in 20 minutes for our lunch break?

MS. BAUGHMAN: Sure.

MS. O'LEARY: All right. Can we go off record for -- just briefly.

THE VIDEOGRAPHER: The time right now is 11:39 a.m. We are off the record.

(Whereupon, there was a recess taken from 11:39 a.m. to 11:39 a.m.)

THE VIDEOGRAPHER: The time right now is 11:39 a.m. We are back on the record.

MS. O'LEARY: Thank you. Professor Aral, we are going to stay in the same exhibit, it's the Tarawa Terrace chapter A report.

Oh, sorry. I guess that's not the

same, is it? It's going back from the environmental report. It should be -- it should have --

THE WITNESS: Chapter A?

MS. O'LEARY: Chapter A. It should have a sticker that says --

THE WITNESS: Exhibit 3?

MS. O'LEARY: -- Government Exhibit -- yes.

THE WITNESS: Okay.

MS. O'LEARY: You are ahead of me.

THE WITNESS: Okay.

BY MS. O'LEARY:

Q Okay. Can you go to page A26 in the -- you should see a table A8.

A Yes.

Q Okay. So this table, it says it's a, "Summary of calibration targets and resulting calibration statistics for simulation models used to reconstruct historical contamination events at Tarawa Terrace and vicinity, U.S. Marine Base Camp Lejeune, North Carolina."

And the question I have for you is about the third line. So the column on the left says there's a "calibration level" and then next to it it

says "analysis type."
So the Calibration Level 3 says it's, "Contaminant fate and transport supply wells."
Do you see that?
A Yes.
Q And then is -- is this saying that the calibration target for contaminant fate and transport at the supply wells was one half order of magnitude or model bias ranging from 0.3 to 3?
A That's what it says, yes.
Q Okay. And is it -- is it saying if you look at number four the calibration level four --
(Whereupon, the court reporter requests clarification.)
BY MS. O'LEARY:
Q The calibration level four, is it saying the -- for the mixing model treated water at the water treatment plant --
(Whereupon, the court reporter requests clarification.)
BY MS. O'LEARY:
Q Treated water at the water treatment plant, the calibration target is the same as in contaminate fate and transport at supply wells. So that plus or minus one half order of magnitude or

model bias ranging from 0.3 to 3.
A Yes, I see that.
Q Okay. Is --
MR. DEAN: For the record, the document reflects that there are two footnotes. Specifically, footnote number two that's applicable to calibration levels three and four and you did not point that out to the witness.
MS. O'LEARY: Okay. That -- that footnote says there's more details in chapter F report; correct?
MR. DEAN: Correct.
MS. O'LEARY: Yeah.
BY MS. O'LEARY:
Q So Professor Aral, you said that's what the table says. Is that your understanding of what the calibration targets for calibration levels three and four were, the plus or minus one half order magnitude or model bias ranging from 0.3 to 3?
A That's what the table says, yes.
Q But I mean, from your memory, is that what they in fact were, the calibration targets?
A I think we looked at the ensemble of what we see at the water treatment plant as opposed to

specific numbers being in a certain range.

Q Is that at Hadnot Point or Tarawa Terrace, where you looked at the ensemble?

A I think with respect to mixing model, it was also Tarawa Terrace.

Q Would that be in the Tarawa Terrace reports somewhere?

A I don't recall.

Q If we could go to -- this will be 60, which is Exhibit 9, that you should have. It's the chapter F report.

A Yes.

Okay.

Q Okay. On page 33 --

MR. DEAN: F33?

MS. O'LEARY: That's right.

MR. DEAN: Okay.

BY MS. O'LEARY:

Q And...

A Yes.

Q Okay. So Professor Aral, on F33, on the left-hand side you should see a table F13.

Do you see that?

A Yes.

Q Okay. And then -- oh, I'm sorry. I

directed you slightly off.

Can you go back one page to F32? So just the previous page.

Okay. Underneath the table there, there's some text. And in the column on the left there's a paragraph that begins, "Simulated and corresponding observed PCE concentrations at Tarawa Terrace and local water supply wells are listed in table F13 and are portrayed in this report as a scatter diagram, F12, and as time-series graphs at individual wells, figures F13 to F17."

Do you see that?

A Yes.

Q And then if we go onto the next page, we have F13, the table.

Do you see that?

A Yes.

Q And then there's a figure 12 as well on F33.

A Yes.

Q Do you see that?

Okay. So do you agree that table F13 shows all of the supply well observed PCE measurements that were used for calibrating, in level three, the contaminant fate and transport

model?

A Can you speak louder, please?

Q Yeah.

Do you agree that table F13 --

A Yes.

Q -- shows the supply well observed measurements that were used for calibrating the contaminant fate and transport models, so level three?

A I believe so, yeah.

Q Okay.

A I mean, I have to check every one of them separately. If they have made a typo error, I'm not sure.

Q Okay. Do you have any reason to think they have made a typographical --

A I don't --

Q -- error?

A -- think so.

Q And as you look at table F13, do you agree that these observed measurements are only from the years 1984, 1985, and 1991?

A Where did you see the '84? I didn't see the '84.

Q Actually, right. I don't see the 1984.

So only 1985 and 1991?

A That seems correct.

Q Okay. So if this table is the observed measurements that were used for calibrating contaminant fate and transport --

A Yes.

Q -- does that mean the Tarawa Terrace fate and transport model was calibrated without observed concentrations from 1953 to 1984?

A That's correct.

MS. O'LEARY: Then can we get 59?

(Whereupon, Government's Exhibit Aral 10, Document, was marked for identification.)

MS. O'LEARY: There you go. This will be Government Exhibit 10.

BY MS. O'LEARY:

Q And if you could go to page A10, please?

A Yes.

Q So there -- table E5 there says --

A Yes.

Q -- "Summary of selected analyses for tetrachloroethylene, PCE; trichlorethylene, TCE; and total dichloroethylene, DCE; and water samples collected at monitor wells during ABC One-Hour

Cleaners operable units one and two, and by the North Carolina Department of Natural Resources and Community Development, Tarawa Terrace and vicinity, U.S. Marine Base Camp Lejeune, North Carolina."

Do you see that?

A Yeah.

Q Am I correct in understanding that these PCE and TCE measurements from monitor wells around ABC One-Hour Cleaning -- Cleaners, excuse me, were not used in calculating the fate and transport model of Tarawa Terrace?

A If I recall this report, there were 36 databases that were used. And if this is the 36 database that -- that existed in that analysis, that must be it.

Q Well, if -- if you go back to Exhibit 9, which was chapter F that we were just looking at, we were just looking at table F13. So that was on page F33.

A Okay. I think this table refers to monitoring wells, the other table refers to pumping wells.

Q To supply wells, right?

A Supply wells.

Q Yes. And so am I correct in

understanding that these monitoring well measurements in table E5 were not used in calibrating the fate and transport model?

A I think you should ask the author of that.

As far as I know, the numbers of wells that were used in calibrating this model was 36. And that was the total available database at the site at that time.

Q Right. So just -- if we go back to table F13, that was on page F33, there are 36 entries --

A Okay. So --

Q -- in that table?

A Okay. If that's the case, then that's the 36 number that is coming to my mind.

Q So that's all that was used for calibrating --

A Right.

Q -- the fate and transport model?

MR. DEAN: Object to the form.

A That was reported in chapter F as such, yes.

BY MS. O'LEARY:

Q Okay. And I'm going to go back to Tarawa Terrace chapter A. And --

MR. DEAN: I feel like I'm playing tennis.

BY MS. O'LEARY:

Q -- page A16.

So I have some questions for you about mass loading at Tarawa Terrace.

A Yes.

Q Okay. On page A16, there is a figure, figure A3 that says it's a, "Chronology of events related to supply and contamination of drinking water, Tarawa Terrace and vicinity."

Do you see that?

A Yes.

Q Okay. I see in figure A3 in -- there's an entry for 1953 that says "ABC One-Hour Cleaners begins operations using existing ST-STA" --

(Whereupon, there was an interruption.)

BY MS. O'LEARY:

Q -- "ST-STA for disposal of wastewater."

Do you see that?

It's --

A Okay.

Q -- here.

A Yes.

Q Okay. Was the start date of ABC Cleaners used as an input in the Tarawa Terrace water models?
A I think it was 1953.
Q Okay. Was that input as a start of mass loading date in the Tarawa Terrace models?
A Yes.
Q Okay. Is the start of the mass loading significant to the output of the model?
MR. DEAN: Object to the form.
A It affects the output, yes.
BY MS. O'LEARY:
Q Okay. And did you -- no.
If I look again at figure A3, it says, in the -- the third bar down on the left, around 1960 --
A Uh-huh.
Q -- the's an entry that says "1960s ABC One-Hour Cleaners installs floor drain to septic system."
Do you see that?
A Yes.
Q Okay. Did ABC -- did the ATSDR model of Tarawa Terrace include changes in the mass loading rate of PCE?
A Mass loading rate in our models were

calibration parameters. That's what we did in calibration, used numbers to adjust the mass loading rate to match the water --

(Whereupon, the court reporter requests clarification.)

A -- match the water treatment plant concentrations.

BY MS. O'LEARY:

Q Okay. But the input that was used in the calibrated TT-model for mass loading of PCE --

A Uh-huh.

Q -- was that constant throughout the Tarawa Terrace model timeframe from when it started to when it stopped?

A That's correct.

Q Okay. So does that mean the model did not have any change in mass loading that would correspond to this ABC One-Hour Cleaners installing floor drain to septic system?

A That -- that's a internal process where the contaminants gets into the aquifer system. We are not looking at the internal processes of how contaminants are manipulated in the ABC cleaners. We are interested in what is discharged into the aquifer as a dilute phase contaminant level.

Q So if ABC Cleaners changes where they -- where they discharged their -- you know, whatever waste had the PCE, if that changed location, wouldn't that change how the contaminant moved through the aquifer?

MR. DEAN: Object to the form of the question.

A I mean, if you are talking about acres of land and you are talking about distances of miles, kilometers, discharge points separately discharging into an aquifer, it would affect the groundwater models. But ABC Cleaners is -- I assume is a point in our modeling idealization.

BY MS. O'LEARY:

Q What do you mean, is a point in our modeling idealization?

A In modeling we use mesh -- meshes. We describe the aquifer in terms of blocks of subsurface environments --

Q Uh-huh.

A -- that we input parameters that we know are coming from the -- either the aquifer database or the source database. This model is so large that the ABC Cleaners entry point is just a point on that mesh.

Q And -- and --
A It can't be more than that.
Q So if I understand correctly, then it spreads through the mesh according to the way the model operates?
A That's correct.
Q Okay. But AB- -- but the model had just constant mass loading?
A Yes, constant mass loading.
Q Okay.
A Whatever the calibrated value was.
Q Uh-huh. And we are going to go back to chapter F again, which is Exhibit 9.
A Okay.
Q And to page 12.
A F12 --
Q Yes.
A -- did you say?
Q And there's a table on the left, and on the right there's text.
A Okay.
Q Okay. That column on the right, at the top it says, "ABC One-Hour Cleaners always used PCE in its dry cleaning operations beginning during 1953 when the business opened.

"Hoff (phonetic) and" --

(Whereupon, there was an interruption.)

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q Yeah.

"...when the business opened.

"Hoff and Higley PA (phonetic) deposition of Victor John Milts (phonetic) written communication April 12, 2001.

"A primary pathway of contaminants from drive cleaning operations at ABC One-Hour Cleaners to the soil and subsequently to groundwater was apparently through a septic tank soil absorption system to which ABC One-Hour Cleaners discharged waste and wastewater."

And it says, "Shriver 1985 reported that an inspection of the PCE storage area at ABC One-Hour Cleaners indicated that PCE releases could and did enter the septic system through a floor drain probably as a result of spillage in the storage area."

That's Roy F. Weston Inc. 1994. In addition -- F. Weston, Inc., 1994.

"In addition, spent PCE was routinely reclaimed using a filtration distillation process that produced dry still bottoms which, until about 1982" -- I'm going to skip the parenthetical -- "or 1984 and 1985, were disposed of on site generally by filling potholes in a nearby alleyway."

So do you agree that on this cat- -- this description in chapter F, the septic soil -- tank soil absorption system around ABC Cleaners was a primary pathway of contaminants from the dry cleaning operations?

A Yeah. Probably. Yes.

Q Okay. And are you aware based on -- you know, does it follow from what this paragraph said that ATSDR knew that ABC One-Hour Cleaners still waste was disposed of outside until 1982 or 1984 or 1985?

A In terms of location that doesn't make any difference for us.

Q But that -- that -- that is what ATSDR knew about disposal practices; correct?

A It seems so, yeah.

MR. DEAN: Objection to form.

BY MS. O'LEARY:

Q Okay. If the -- does the time when ABC

Cleaners stopped disposing of their solid still waste outside affect how the model performs in terms of accuracy?

So what I mean is if -- you know, if the ABC Cleaners stopped disposing of their solid still waste in potholes in 1982, would that be expected to reduce modeled contaminant concentrations?

MR. DEAN: Object -- object to the form.

A If you are referring to how we model the discharge from the ABC Cleaners, we looked at two different applications. One of them discharging at a point in the saturated zone --

BY MS. O'LEARY:

Q Uh-huh.

A -- that's the MT3DMS model --

Q Uh-huh.

A -- application. The other one is the discharging of the ABC Cleaners contaminants in the -- in the unsaturated zones of the aquifer. That's the TechFlowMP model.

So we looked at two different cases but both of them on a large scale map in a idealization that we have used is just a point.

Q Okay. And so that's one point. Is that

on the boundary of one of the 50 by 50-foot, like, squares --
A Yeah.
Q -- in the mesh?
A Yeah.
Q Okay. I have a question about the calibration process for mass loading at --
A Okay.
Q -- Tarawa Terrace.
So this is on page -- to start on page F30 of chapter F, which is Exhibit 9.
A Okay.
Okay.
Q All right. So there's text underneath the figure on that page.
Do you see that?
A F11?
Q No, I'm sorry.
F30.
A Yeah. F30, yeah.
Q F30. Okay.
So the text at the bottom of that page --
A Yeah.
Q -- in the column on the right-hand side near, sort of, the middle there's a sentence that

begins, "The initial mass loading rate."
Do you see that?
A Yes.
Q Okay. It says, "The initial mass loading rate applied to the model was 230 grams per day and was adjusted upward during model calibration. The final calibrated mass loading rate was 1200 grams per day."
And I was wondering why did you start with 230 grams per day?
A I think it was estimated the volume of discharge from a cleaner operation.
Q Like, an average cleaner operation or --
A No. Beginning operation -- beginning value for a calibration application.
Q Specific to a dry cleaner?
A Yeah.
Q Okay. And how did you end up at 1200 grams per day?
A Oh, we -- calibration means that. You adjust the parameter values to match the field data. So to get to the field data we observed in water treatment plant we had to increase the mass loading rates to that level.
Q Okay. And staying in chapter F, if you

can just go back to page F28?

A Okay.

Q And there's a section in the column on the right that's got the heading "Biodegradation."

Do you see that?

A F23, did you say?

Q F28?

A Twenty-eight.

Yes. Yes.

Q So under, "Biodegradation," it says, "Reductions of PCE concentration reported at water supply well TT-26 between September 1985 and July 1991, table F2, probably occurred largely by microbial mediated degradation such as reductive dechlorination."

And does that mean that biodegradation is called biodegradation because it involves microbes in the processes?

A Yes.

Q Okay. And does biodegradation rates of PCE depend on anything?

What I mean is, is the biodegradation rate of PCE always the same?

A Probably changes by temperature.

Q Okay. Would it vary by what microbes are

in the environment where the PCE is?
A I think biodegradation, referred to here, is the biodegradation of the chemical itself.
Q Right. Of -- of like --
A Right.
Q -- PCE into --
A Right.
Q -- TCE and on?
A Right.
Q Yeah. So -- so my questions are about the rate that that happens.
A Uh-huh.
Q So, you know, you mentioned temperature might affect that rate.
A Right.
Q What else would affect the biodegradation rate of PCE?
A Microbes are used sometimes to treat the contaminants. So my understanding is that the microbes in the aquifer affects the concentration values that is out there.
Q That's my last question on that area for a minute. Moving onto some questions about other parameters that were input into the Tarawa Terrace model.

First, what is bulk density?
A That's the dry density of soil.
Q Okay. And is bulk density used to calculate a retardation factor for a -- a particular chemical?
A That's correct.
Q If bulk density were calculated incorrectly, would that affect a calculation for a retardation factor?
A Yes, it does.
Q And if a bulk density value were calculated too high, would that cause a retardation factor to be higher or lower?
A If you are not changing any other parameter in that equation, it will be higher.
Q Okay. So they would vary together, bulk density and retardation factor?
A Yeah.
Q Okay.
A But there are other parameters in that equation.
Q Sure. Sure.
A Okay.
Q And then what is a distribu- -- distribution coefficient or KD?

A Okay. That describes the amount of soil that may be absorbed or -- a contaminant that may be absorbed on the soil system.

Q Ah. So it would be removed from a plume --

A Right.

Q -- by the soil?

A That's right.

Q Okay. And is it calculated by the fraction of organic carbon multiplied by an organic carbon water partition coefficient?

A That's correct.

Q So is fraction organic common -- carbon, excuse me, often called FOC?

A Yes.

Q And is the organic carbon water partition coefficient often called KOC?

A That's correct.

Q And is distribution coefficient often called KD?

A That's correct.

Q If bulk density were calculated incorrectly, would that have an impact on KD?

A No.

Q No. Okay.

If FOC were determined incorrectly, would that impact KD?

A Yes, of course.

Q Because it's multiplied by that --

A Right.

Q -- partition coefficient?

A Right.

Q And we'll stay in chapter F, I think right where -- around where we were.

Can you go to page F27, that goes to page F28?

A Yes.

Q All right. In the column on the right, the last paragraph starts, "Estimates of retardation factors."

Do you see that?

A Yes.

Q Okay. It says, "Estimates of retardation factors and distribution coefficients for PCE migration within the Tarawa Terrace aquifer or Castle Hayne aquifer are unknown, and initial estimates applied to the MT3DMS model were based on literature sources. Roberts, et al., 1986 reported retardation factors determined from a field scale investigation of PCE migration through a sand

aquifer that ranged from 2.7 to 5.9 based on the collection of high resolution synoptic data during a period of about two years.

"Retardation factors increased directly with increasing time but at a decreasing rate. Hoffmann, 1995, reported highly controlled laboratory column determination of distribution coefficients for PCE migration through gravels, sands, and silt.

"Of the approximately 150 samples analyzed the distribution coefficients for sand ranged from 0.25 to 0.76 milliliters per gram, and averaged 0.39 milliliter per gram. Corresponding values for silts ranged from 0.21 to 0.71 milliliters per gram and averaged 0.4 milliliters per gram.

And it goes on to say that, "Neither the field scale experiments reported by Roberts, et al., 1986, know that -- nor the laboratory results of Hoffmann 1995 related to Camp Lejeune or even to North Carolina, the solute investigated in both studies was PCE. And PCE migration was observed through porous media of sands and silt -- sand and sands and silts similar to Camp Lejeune."

Did I read that correctly?

A Yeah.
Q Okay. So am I understanding correctly that the ATSDR had determined estimates of KD, distribution coefficients and retardation factors within the Tarawa Terrace aquifer and Castle Hayne aquifers, were unknown?
A Yeah. That the -- from what -- what you just have read, I think it's coming from literature -- literature data.
Q Okay. So in -- in calibrating the ATSDR's Tarawa Terrace model, did ATSDR select an initial KD value from the literature values that were reported?
A That's what it seems, yes.
Q Okay. And --
A But there's also data on KD at the site, as far as I recall.
Q Is it KD or FOC data at the site?
A I don't recall completely but I think it was KD.
Q Okay. So from what we read on F27 to 28, the literature range ATSDR reported for KD averaged 0.39 milliliters per gram with a range of 0.25 to 0.76 milliliters per gram for sands.
Right?

A Uh-huh. Yeah.
Q And for silts, it was an average 0.4 milliliters per gram and a range of 0.21 to 0.71 milliliters per gram.
A Uh-huh.
Q Okay. And that literature range was from laboratory experiments on sands or silts but not related to Camp Lejeune or North Carolina.
A That's right.
Q Okay.
A That's right.
Q And after calibration, am I correct that the ATSDR selected 0.14 milliliters per gram as the KD for the Tarawa Terrace calibrated model?
MR. DEAN: Object to the form.
A Well, that seems to be the number that -- where -- where did you get that number? I don't --
BY MS. O'LEARY:
Q It wasn't in that part but I thought you might know that. That the --
A No. Not on the top of my head, no.
Q Okay. Would you agree that 0.14 milliliters per gram is lower that ten literature ranges ATSDR reported for both sands and silts?
A Uh-huh.

MR. DEAN: Object to form.

BY MS. O'LEARY:

Q For calculating KD, you had agreed that that was done by multiplying the fraction of organic carbon by that --

A Yes.

Q -- partition coefficient, KOC; is that right?

A Yes.

Q The KOC, the organic carbon water partition coefficient, is that compound specific or different for PCE than TCE?

A It's compound specific --

Q Yes.

A -- of course.

Q Of course. Okay.

And is --

A Yeah.

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q Sorry.

Are values for the organic carbon water partition coefficient for each chemical available in literature?

A Yeah.
Q Okay. You said that you had read Alex Spiliotopoulos's report.
Did I hear you correctly?
A Yes.
Q And I -- I believe he included tables with fraction of organic carbon measurements from Camp Lejeune.
A Yes.
Q Do you know why the ATSDR didn't use those FOC estimates?
MR. DEAN: Object to the form.
A I don't know.
BY MS. O'LEARY:
Q Like, did -- did the ATSDR use those fraction organic carbon estimates when they were calculating KD for Tarawa Terrace?
A I don't know what they have done to come up with these retardation coefficients. But if that was available, I'm sure they have used it.
Q Okay. Do you -- if the fraction organic carbon data from Camp Lejeune were buried significantly --
A It -- it will -- it will vary by soil type, definitely.

Q Okay. Would that -- if it varies, would that be a reason not to use it to calculate the --
A I wouldn't know --
Q -- KD?
A -- why they have not used it if they have not used it.
Q But if you had fraction organic carbon data that varied a lot, would that cause you not to use it in determining a KD?
MR. DEAN: Object to the form of the question.
A It's -- it's a judgment call. If -- if you know enough information on what is at the site, it may be better to use it.
BY MS. O'LEARY:
Q Okay. And this -- I think you mentioned this phrase but I just wanted to check my understanding of what it is.
So you mentioned retardation factor, I believe?
A Yes.
Q What is a retardation factor?
A Due to absorption of chemicals in a soil, it acts as if -- a reduction factor of the velocity of the contaminants in the aquifer.

Q A reduction in velo- -- velocity relative to what?
A To the retardation coefficient of one.
Q Is that for water, the "one"?
A No, it's not a water issue.
It's -- it's a issue of density. It's a function of distribution coefficient and the porosity.
Q Okay.
A You may ignore retardation factor --
Q Uh-huh.
A -- or you may calculate it as ATSDR has done.
Q And if you calculate it, then that's going to be a retardation factor specific to a compound?
A The distribution coefficient is specific to a compound --
Q And --
A -- because KOC is a --
Q Right.
A -- specific to a compound.
Q And so -- and -- and distribution coefficient is used in calculating the retardation factor though; correct?

A Can you speak --
Q Yeah.
A -- louder, please?
Q A distribution coefficient is used in calculating a retardation factor; correct?
A That's correct.
Q Okay. So a particular calculated retardation factor is going to be specific to a compound; correct?
A That's correct.
Q Okay. And as K- -- KD, distribution coefficient, increases, what happens to retardation factor?
A All the other parameters kept constant --
Q Right.
A -- retardation increases.
Q Okay. And as retardation factor increases, does that mean the contaminant is moving more slowly relative to the groundwater flow --
A Yes --
Q -- speed?
A -- that's correct.
Q Okay.
MS. O'LEARY: And I want to, actually, turn to -- actually, this would

actually be a good place to stop.

MS. BOLTON: Yeah.

MS. O'LEARY: Do we know if lunch has arrived?

MS. BOLTON: I think it's here.

MS. BAUGHMAN: It's here.

MS. O'LEARY: Then we'll take a break now.

Thank you.

THE WITNESS: Okay. Thank you.

THE VIDEOGRAPHER: The time right now is 12:18 p.m. We are off the record.

(Whereupon, there was a recess taken from 12:18 p.m. to 1:00 p.m.)

THE VIDEOGRAPHER: The time right now is 1:00 p.m. We are back on the record.

MS. O'LEARY: Thank you.

BY MS. O'LEARY:

Q And Professor Aral, if you could pull back up Government Exhibit 9, the chapter F report --

A Uh-huh.

Q -- for Tarawa Terrace and then go to page F28?

A Uh-huh.

Q And in the column on the left, the first paragraph, the bottom of that paragraph, it says, "An initial distribution coefficient."

Do you see that?

A Yeah.

Q Okay. So it says, "An initial distribution coefficient of 0.4 milliliters per gram or 0.000014 cubic feet per gram was applied uniformly to all layers of MT3DMS model for all stress periods. The final calibrated value was 0.14 milliliters per gram" -- skipping the parenthetical -- "similarly applied and the calibrated retardation factor was 2.9."

So Professor Aral, having seen now that page, do you agree that in the calibrated model for the Tarawa Terrace, the -- the distribution coefficient was 0.14 milliliters per gram?

MR. DEAN: Objection to the form.

A The retardation coefficient was 2.9.

BY MS. O'LEARY:

Q Right. But do you agree the distribution coefficient was the 0.14 milliliters per gram?

MR. DEAN: Same objection.

A Yeah, but I don't recall that number. It

depends on whether it was a number related to the corrected density or earlier density, which was used.

BY MS. O'LEARY:

Q What do you mean "corrected density"?

A Well, in MT3DMS, I think there was a problem which was recognized in terms of density values, what density was not used and the other wet density was used. So it was corrected.

So I don't recall this number. If this is the corrected value, it must be correct.

Q And who corrected the bulk density value in --

A Bob Faye.

Q -- in MT3DMS?

A Bob Faye.

Q Bob Faye.

And where would you expect a record of that correction on bulk density to be in the reports?

A Was I aware of that?

MR. DEAN: Object to the form.

It's not in the report --

A Was I aware of that or how would I know that or --

BY MS. O'LEARY:

Q Well, you said that --

A What's the question?

Q Yeah. You said that Bob Faye --

A Uh-huh.

Q -- caught the bulk density error.

A Uh-huh.

Q And I asked where you would expect the fact that Bob Faye corrected bulk density to be in the ATSDR reports?

MR. DEAN: Object to the form. It's not in the reports.

A Bob density -- Bob Faye corrected the bulk density value and adjusted the distribution coefficient to the observations that he has in his hand, and the result came out to be the same retardation coefficient that you are reporting here.

BY MS. O'LEARY:

Q Retardation coefficient or distribution coefficient?

A Retardation coefficient.

Q Do you mean retardation factor?

MR. DEAN: Objection to the form.

A Retardation factor. It's the same terminology.

BY MS. O'LEARY:
Q So do you have any reason to think that what's listed in the chapter F report as the final calibration value for distribution coefficient -- so 0.14 milliliters per gram --
A I assume --
Q -- is wrong?
A -- this -- this -- I have assumed this is the correct number.
Q The zero -- 0.14 milliliters --
A Yeah.
Q -- per gram?
Okay.
A Yeah.
MR. DEAN: Object to the form. The report --
MS. O'LEARY: And --
MR. DEAN: -- is dated February 2008.
MS. O'LEARY: And I'd like to move -- this will be number 40, supplement six from the Hadnot Point reports.
It looks like this will be Government Exhibit 11.

THE WITNESS: Okay.

(Whereupon, Government's Exhibit Aral 11, Supplement Six from the Hadnot Point Reports, was marked for identification.)

THE WITNESS: Thank you.

MR. DEAN: Thank you.

BY MS. O'LEARY:

Q And Professor Aral, I'd like to go to page S6.14, so 14.

A Say that number again, please?

Q Yeah. S6.14. It will be on the bottom --

A Of which page?

Q -- left of the page.

A Okay.

Q Yeah. The page numbers start S6 on all of them.

A Yeah. One, four.

Yeah.

Q Okay. So there's a section labeled "Sorption." Under that it says, "Sorption in the HP, HB study area is assumed to be similar to sorption in the TT study area of USMCB Camp Lejeune described in Faye 2008."

"Sorption processes, i.e. adsorption and absorption for HPIA and HPLF models were represented in MT3DMS by using a linear isotherm sorption model. The input data required to simulate sorption included porosity, distribution coefficient, and soil bulk density. Constant values were assigned to the aforementioned model parameters throughout the model owing to the lack of site-specific field data. MT3DMS uses values assigned to porosity, distribution coefficient, and soil bulk density to compute a retardation factor."

And then we'll stop there.

So Processor Aral, do you agree that data sorption in MT3DMS -- or excuse me. Let me back that up.

Do you agree that MT3DMS was used in both Tarawa Terrace and Hadnot Point/Holcomb Boulevard water models?

A Can you repeat that --

Q Yeah.

A -- question louder, please.

Q Was --

MS. BAUGHMAN: Actually, if you don't mind, I meant to put something on the record about that.

We -- we talked to Dr. Aral at the break about the fact that he can't hear you. And he's guessing at what you are asking him often because he feels he doesn't feel comfortable continuously asking you to raise your voice.

So you are risking having a record that is not reliable and I'm -- I'm -- I'm putting you on notice right now: If you don't raise your voice, he can't hear you. He doesn't feel comfortable continuously asking you so you need to raise your voice.

You are not -- when we ask you to raise your voice, you are just repeating the question and not making it louder.

BY MS. O'LEARY:

Q Professor Aral, are you uncomfortable asking me to speak more loudly?

A Yes, I am.

Q Okay. Why?

A Because I'm a person of certain values and standards. I cannot keep asking the same question to the person I'm talking to.

I expect that person to respond to my

question in the first time that they hear the question.

Q Well, if you can't understand me, please ask me to speak louder.

A Well, you may say that but I have a personality that doesn't allow me to do that.

Q So --

MS. BAUGHMAN: So our request is that you continuously raise your voice.

BY MS. O'LEARY:

Q Professor Aral, do you agree that the MT3DMS was used in both the Tarawa Terrace and Hadnot Point/Holcomb Boulevard water models?

A That's correct.

Q And do you agree that MT3DMS uses input values related to porosity, distribution coefficient, and soil bulk density?

A Yeah.

Q And do you agree, based on what it says here on page S6.14, that the ATSDR concluded that sorption in the Hadnot Point/Holcomb Boulevard study area was similar to sorption in the Tarawa Terrace study area?

A That's what it says.

Q And do you agree that MT3DMS is a model

that is trying to simulate sorption?
A I have not used MT3DMS lately so I don't remember the details of the input parameters on it.
Q I mean, the input parameters of porosity, distribution coefficient, and soil bulk density are -- are in what we just --
A Yeah. But --
Q -- read.
A -- you are talking about sorption.
Q Right.
A You asked that.
Q But those input parameters relate to sorption, don't they?
A Adsorption and sorption is the same thing? I don't think so.
Q Well, what is the difference?
Aren't they both two examples of sorption?
A No, it's not.
Q How are they different?
A One of it is absorption into the soil --
Q Uh-huh.
A -- particles, the other one is absorption -- sorption onto the surface of soil particles. There's a big difference.

Q Okay. But for -- does MT3DMS model both?
A That's what I said, I have not used MT3DMS lately. So if there's a distinction between adsorption and sorption --
Q Uh-huh.
A -- whether it addresses that, I don't remember that.
Q But what does that have to do with porosity or distribution coefficients or soil bulk density and whether those would be similar at Tarawa Terrace and Hadnot Point --
A That's correct.
Q -- Holcomb Boulevard?
A But those refer to retardation coefficient evaluation, not sorption.
Q Isn't the retardation factor trying to be a way to account for --
A It --
Q -- sorption?
A No. It accounts for adsorption.
Q Right.
A Uh-huh.
Q Okay. Did you -- why would -- or, sorry.
Going on -- still on page S6.14 at the top of the column on the right --

A Okay.
Q -- it says, "Typically, KD values are calculated based on laboratory scale experimental data that quantify partitioning behavior for a chemical in simple systems, e.g. octanol water in field data are estimates, for the amount of organic material present in the soil or aquifer material of interest.
"Model specific KD values for benzene, 0.11 liter per kilogram; TCE 0.15 liters per kilogram; and PCE, 0.3 liters per kilogram were derived by using partitioning data for each chemical. An assumed value of 0.002 for the site specific organic carbon fraction of aquifer material and refinement during the model calibration process. Final model-specific KD values are well within the range of values calculated for multiple sources of partitioning data."
So do you agree that in the calibrated model for Hadnot Point, the ATSDR used 0.3 liters per kilogram for PCE?
A This is what this report indicates. That's --
Q Do you have any --
A -- correct.

Q -- reason to think that's incorrect?

I'm sorry, I -- I interrupted you. What were you saying?

A Do I have any -- do I have any reason to believe that these numbers are incorrect?

Q Are not what the ATSDR used in the Hadnot Point model.

A Well, they -- they say that they have used it. I haven't written this report so they must have used it.

Q Okay. Is 0.3 liters per kilogram equivalent to 0.3 milliliters per gram?

A I have no idea.

Q You don't know?

A No, not on the top of my head. I need a calculator, maybe a computer to do -- to evaluate that.

Q Aren't there one thousand milliliters in a liter and one thousand grams in a kilogram?

A I'm so tired. I can't do that off the top of my head.

Q Okay. And do you know why the ATSDR decided to use a different distribution coefficient in Hadnot Point than what they had used in Tarawa Terrace, even though they had said they assumed

similar sorption?

MR. DEAN: Object to form.

A Again, you are using sorption instead of adsorption.

BY MS. O'LEARY:

Q Uh-huh.

A Sorption is a different process.

I don't know what you are referring to in terms of KD values referring to sorption.

Q Well, why did the ATSDR mention in this section on sorption --

A I --

Q -- and KD values that they felt the sorption in the two study areas was similar?

A I have not written this report so I will not be able to answer that.

Q Okay. Can we go back to the Tarawa Terrace chapter A report which is Government Exhibit 3 and go to page A41.

(Whereupon, there was a discussion off the record.)

BY MS. O'LEARY:

Q Okay. Were you involved in the analysis of degradation by-products in the Tarawa Terrace model?

A Yes. I was involved in the use of TechFlowMP model in degradation by-products.
Q Okay. In page A41, in the column on the right near the top -- this actually starts the fourth line from the top -- there's a sentence that says, "The biodegradation rate was determined from field data and the calibration process."
Do you see that?
A Yeah.
Q Does that match your understanding of how the biodegradation rate was determined in Tarawa Terrace?
A It was a calibration parameter, definitely. Probably we have started with some initial values that we expected to see in the soils of Camp Lejeune as a generic database.
So that's the starting point.
Q What do you mean from a "generic database"?
A Well, for example, there's a characterization of the aquifers in the Camp Lejeune. Different soil types has different values for these parameters. Probably we used those soil types to come up with the generic values that we started with, then calibration parameter takes

precedence and adjusts itself.

Q When you say "generic values," do you mean from measurements at the site or from, like, literature reference values?

A Its says here "biodegradation rate was determined from field data." So there must be some field data that we have used in that.

Q That would mean from Camp Lejeune?

A Yeah.

Q Okay. And --

A That's what I understand.

Q And then if you could go to the Tarawa Terrace chapter F report, which is Government Exhibit 9, and to page F28?

A Yes.

Q And there's a column on the right, and it says, "Biodegradation."

Do you see that?

That -- there's a label in the column on the right --

A Uh-huh.

Q -- that says, "Biodegradation." And then there are some, like, values listed. And I want to turn --

A Can you show me on that?

Q Yeah.
A Oh.
Q So here's biodegradation and then can you look at --
A What did you say, F20 or F28?
Q F28.
A Okay.
Yeah. Okay.
Q Okay. So in that biodegradation section, the -- the last paragraph.
A Yeah.
Q Okay. So there it says, "The PCE concentrations at water supply well TT-26 on September 25, 1985, and July 11, 1991, were 1100 and 350 micrograms per liter, respectively. And the elapsed time was 2,151 days. Applying these data to equation three yields a degradation rate of 0.00053 per day."
Do you see that section?
A Uh-huh.
Q Okay. And so trying to relate what we just read in this chapter F to what we just saw in chapter A about field data for biodegradation rate, am I understanding then that these measurements at TT-26, the September 25th, 1985 and July 11th, 1991,

those are the field data where ATSDR started with to calculate biodegradation rate?

A Probably, yeah.

Q Okay. Do you see anything in here describing a calibration process where that was refined?

MR. DEAN: Object to the form.

A In reference to this?

BY MS. O'LEARY:

Q To the biodegradation rate.

A In reference to the MT3DMS application or TechFlowMP application?

Q Well, as I look at chapter F, page F28, I don't see any dis- -- reference to whether it's MT3DMS or TechFlowMP or both.

A Yes --

Q It's just saying --

A -- exactly. But this report that you are showing me, chapter F, is PCE analysis coming from MT3DMS.

Q Uh-huh.

A You started your questioning by asking me biodegradation rates of TechFlowMP, now you are showing me chapter F --

Q Yeah.

A -- again, which is MT3DMS analysis.

Are you asking me whether we have used these numbers in TechFlowMP, or what is the question here?

Q I mean, that is an eventual question, yes. Did you --

A Okay.

Q -- use the same --

A Can you repeat that question to me now?

Q Did you also use degradation rate of 0.00053 per day in TechFlowMP?

A That --

MR. DEAN: Object to the form.

A -- that could be the starting point but it's a calibration parameter, altogether.

BY MS. O'LEARY:

Q Was that the value in the calibrated model of TechFlowMP?

A I remember biodegradation rates. Probably it was, yes.

Q Okay.

A Probably. I'm not sure.

Q And still on page F28, going -- is it -- it spans F28 to F29.

A Okay.

Q So after the sentence I already read, it says, "Potentiom metric levels shown in figures F7 and F8 indicate that while TT-26 is located on a direct advective pathway from ABC One-Hour Cleaners. This PCE mass migrates down gradiant toward and away from well TT-26. To the extent that migration of PCE mass toward and away from well TT-26 occurred at about equal rates from 1985 to 1991, the computed degradation rate of 0.00053 per day approximates a long term average degradation rate. On the other hand, if a significant quantity of the PCE degraded in the vicinity of well TT-26 was replaced by advection, then the degradation rate computed using equation three is probably a minimum rate."

Do you agree?

MR. DEAN: Object to the form.

A This --

MR. DEAN: Does he agree -- hold on a second.

Object to the form. We agree you read the paragraph correctly but you continue to read to him a -- a report that he did not participate in --

MS. O'LEARY: Yeah.

THE WITNESS: Right.

MS. O'LEARY: No, I under-
MR. DEAN: -- nor did he author.
MS. O'LEARY: I understand that.
BY MS. O'LEARY:
Q My question is, do you agree with what this report says that that biodegradation rate --
A This report --
Q -- would repre- -- would represent a minimum rate if -- if --
MR. DEAN: Objection.
BY MS. O'LEARY:
Q -- travel to and from TT-26 aren't the same?
MR. DEAN: Object to form.
A This report talks about what they have done or Bob Faye has done --
BY MS. O'LEARY:
Q Okay.
A -- on application of MT3DMS.
Q Right.
A I don't know anything about that. I wasn't a part of that modeling. I didn't write this report.
I'm on the record for that.
Q I understand that, Professor Aral. You

did, however, do the TechFlowMP --
A That's correct.
Q -- analysis and that also involved a biodegradation rate --
A That's correct.
Q -- correct?
And you said you think you did use the same biodegradation rate.
MR. DEAN: Object to form.
A I said it was a calibration parameter, as far as I recollect.
BY MS. O'LEARY:
Q Well, what value did you use at TechFlowMP?
A It must be in our reports. I --
Q Okay.
A -- don't have it here --
Q Right.
A -- on the top of my mind.
Q So --
A Yeah.
Q -- would you agree with the concept that's described in what I just read about flow --
A I --
Q -- towards and away from TT-26

affecting --

A I --

Q -- whether this biodegradation --

A I'm going to --

Q -- rate --

MR. DEAN: Objection to form.

MS. O'LEARY: Excuse me, can I finish my question?

MR. DEAN: Sure.

BY MS. O'LEARY:

Q -- whether that bio- --

MS. BAUGHMAN: Dr. Aral, make sure you let her finish the question before you answer, okay?

THE WITNESS: Yeah.

BY MS. O'LEARY:

Q Okay. So to rephrase, do you agree that flow towards and away from TT-26 is not about the same for -- for PCE and its degradation products, then the calculation that was apparently used to come up with 0.00053 would likely represent a minimum rate of biodegradation at TT-26?

MR. DEAN: Object to form.

A I -- I -- you know, you are making statements, like minimum or maximum, without any

value -- evaluation of what it is, okay?
I will not answer that question whether it was a minimum for this application. It could have been a different value for the TechFlow -- TechFlowMP application. So I cannot answer questions related to another chapter and refer my answers to a chapter which is written by me on TechFlowMP.
BY MS. O'LEARY:
Q Yeah.
A So these two models are totally different.
Q No, I -- I under- --
A You cannot -- you cannot compare the values used, the initial values used, whether it was a calibration outcome at the end or not. Those are totally different questions.
If you ask me what TechFlowMP does, how does it do it, I'm ready to answer it. But I'm not going to answer somebody else's report, somebody else's model right now.
Q So my question is not about MT3DMS and it's not --
A But you started with that.
Q This is in a chapter about that but

that's not my question, right?
A Okay.
Q My question is about the science expressed in this sentence, right?
This is not about what MT3D- -- -DMS does. It's a statement about how actual movement would affect biodegradation rate measurement calculation. That's not MT3DMS. It's about inputs that go into both MT3DMS and TechFlow.
So my question is: Do you agree with the scientific statement here about how different rates traveling of contaminants towards and away from TT-26 would impact whether the way this describes calculating a biodegradation rate is accurate?
MR. DEAN: Object to the form.
A The moment of contaminants from A to B doesn't imply or doesn't involve the calculation of biodegradation rates. The --
BY MS. O'LEARY:
Q Sure.
A -- biodegradation rates starts the calculation. The calculation ends up with the moment of the contaminants in the aquifer based on that input data, not vice versa. The flow doesn't determine the biodegradation rates.

Your question is totally out of scientific base.

Q Why?

A I explained to you. You are saying moment of contaminants in the aquifer determines the biodegradation rate. I'm saying --

Q No, that's not what I'm saying.

MR. DEAN: Object to the form.

Please let him finish his answer.

THE WITNESS: Okay.

MS. O'LEARY: Go ahead.

A That's what I understood.

And then you are saying the biodegradation rates are determined based on the flow. That's not correct.

BY MS. O'LEARY:

Q No. What this says on page --

A Can you repeat what --

Q -- on F28 --

A -- it says?

Q Yeah.

What it says on F28 --

A Yeah.

Q -- is that, "Potentiom metric levels shown on figures F7 and F8" --

A Uh-huh.
Q -- "indicate that while TT-26 is located on a direct advective pathway from ABC One-Hour Cleaners" --
A Yeah.
Q -- "thus PCE mass migrates downgradient toward and away from well TT-26. To the extent that migration of PCE mass toward and away from well TT-26 occurred at about equal rates from 1985 to 1991, the computed degradation rate of 0.00053 per day approximates a long term average degradation rate."
Do you agree with that?
MR. DEAN: I'm going to object to the form of the question. I'm going to instruct the witness -- no, I'm not.
You've asked the same question now five times. You are getting to the point of badgering the witness, okay?
MS. O'LEARY: Excuse me.
MR. DEAN: No.
MS. O'LEARY: Let me continue.
MR. DEAN: No. No. We are not --
MS. O'LEARY: No. You are limited to form and foun- and foundation. Let's

continue.

MR. DEAN: No. But I'm going to protect the witness from -- from you harassing him. You are reading to him a report he had nothing to do with and you know that --

MS. O'LEARY: Mister --

MR. DEAN: -- and he's already told you --

MS. O'LEARY: Mr. Dean, let's continue --

MR. DEAN: Let me finish. Let me finish.

MS. O'LEARY: Let's go off the record and we can talk for a few minutes.

MR. DEAN: No, we don't -- I don't want it off the record. I want this on the record --

MS. O'LEARY: Let's go off the record.

MR. DEAN: -- so the Court can read --

MS. O'LEARY: Thank you.

MS. BAUGHMAN: We are not agree to go off the record.

MR. DEAN: I want the Court to read it.

MS. O'LEARY: Well, then please stop interrupting.

MR. DEAN: I'm not interrupting.

BY MS. O'LEARY:

Q So Professor Aral, did you understand when I reread?

My question is do you agree --

MR. DEAN: Asked and answered. Move on.

MS. O'LEARY: No.

BY MS. O'LEARY:

Q Do you agree?

A Repeat the question --

Q Yeah.

A -- please?

MR. DEAN: It's the same question she's asked five, six -- eight times now.

MS. O'LEARY: Evidently, he's not clear on what it is, so --

BY MS. O'LEARY:

Q Figures F7 and F8 indicate that, "While TT-26 is located on a direct advective pathway from ABC One-Hour Cleaners" --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q Okay.

-- "thus PCE" --

MS. BAUGHMAN: And you need to speak louder.

BY MS. O'LEARY:

Q -- "thus PCE mass migrates downgradient toward and away from well TT-26."

A That's correct.

Q "To the extent that migration of PCE mass toward and away from well TT-26 occurred at about equal rates from 1995 to 1991, the computed degradation rate of 0.00053 per day approximates a long-term average degradation rate."

Do you agree with that?

MR. DEAN: Object to the form --

A See the --

MR. DEAN: -- of the question.

A -- the point that I don't agree is that computed biodegradation rate statement written in that report is not correct..

Biodegradation rate was evaluated first -- I mean, that reads like the water

contaminant moment determines, somehow, the biodegradation rates. The computed -- computed refers to the modeling computation.

If it refers to the computed biodegradation rate first as database and that database being used in the model results in that contaminant plume, that's a correct answer.

But that computed implies to me that the biodegradation rate was computed based on what the model results predicted.

BY MS. O'LEARY:

Q What if it --

A That --

MS. BAUGHMAN: Wait.

A -- I don't understand.

BY MS. O'LEARY:

Q Okay. What if it's referring to the two measurements at TT-26?

MR. DEAN: Object to --

BY MS. O'LEARY:

Q -- in the two points in time. So we are talking about September 1985 and July 1991.

If that's what the computed means, then do you agree?

MR. DEAN: Object to the form of the

yes. You are asking him to speculate on a report he did not prepare what that intended sentence means.

A Okay. If the -- if the computed biodegradation rate that was reported in a chapter F report, that I have no contribution to, is used in the MT3DMS model which resulted in the migration of the contaminants from ABC Cleaners towards the TT-26 plumping route, that's the correct definition. That's correct. I agree with that.

BY MS. O'LEARY:

Q Okay. So would you agree then that on the other hand, if a significant quantity of the PCE degraded in the vicinity of well TT-26 was replaced by advection, then that degradation rate computed, using equation three which is on F28, is probably a minimum rate?

MR. DEAN: Object to the form of the question.

A What does -- what does advection got to do with the biodegradation rate? Can you tell me that?

BY MS. O'LEARY:

Q Isn't it talking about how fast the different PCE and its by-products are moving --

A But --
Q -- up and downstream?
A But your statements are not scientifically correct. Please correct your question so that I can answer properly.
Q What doesn't make sense in my question?
A You are associating advection in an aquifer --
Q Uh-huh.
A -- with biodegradation rate. It has nothing to do with that.
Q I'm not trying to associate biodegradation with an advection rate. I'm trying to talk about the effect of two data points that were used for calculating a biodegradation point. Do you appreciate the difference?
A That is a totally different application of the equation three that we have seen in this report.
If you are trying to calibrate a biodegradation rate based on some observed contaminant migration, not simulation --
Q Right.
A -- then that's fine.
Q Okay. So that is what I mean. Not a

simulation --
A Okay.
Q -- I mean calculation from observed data.
A Yeah. But where is that observed data coming from?
Q Well, it -- it says here in chapter F that there were measurements in September 1985 --
A Okay.
Q -- and --
A So there's --
Q -- "Jaloo" 1991 --
A -- field study --
Q Right.
A -- which looked at -- so your question were not complete for me to answer that.
So let's start with the beginning. They have made -- ATSDR has made field studies --
Q Uh-huh.
A -- is that correct?
I mean, I'm not --
Q Well, there --
A -- supposed to start this discussion but --
Q They are -- they are reporting the two values; right?

They are reporting September --
A Is that --
Q -- 25, 1985 --
A -- field study?
Q It is what ATSDR is reporting from the field.
A So you don't know what --
MR. DEAN: Object to the form.
A -- the chapter F is saying --
MR. DEAN: Mischaracterizes --
A -- I don't know what chapter F is saying, so why are we discussing this?
BY MS. O'LEARY:
Q Well, I wanted to see if you agreed with the scientific conclusion they made based on what they reported on data.
A If there's an independent field study that ATSDR has conducted to determine the biodegradation rate, independent of MT3DMS --
Q Sure.
A -- simulations, I accept that.
Q Okay. So then do you similarly accept what the ATSDR says about if, on the other hand, a significant quantity of the PCE degraded in the vicinity of well TT-26 was replaced by advection,

then the degradation rate computed using equation three is probably a minimum rate?

MR. DEAN: Objection to the form of the question. Asked and answered 50 times.

A I -- I have no idea who wrote -- I mean, I know who wrote this report. I didn't write it so I have no idea what this is all about.

BY MS. O'LEARY:

Q Okay. And do you agree that if you have a higher biodegradation rate, that means PCE is going to degrade into TCE, and on, at a faster rate?

A Right.

Q Do you agree that a higher biodegradation rate used in the -- either MT3DMS or TechFlowMP would result in lower PCE concentrations at TT-26?

A As far as I know, MT3DMS application look at -- looked into single species model.

Q I agree.

A Okay. So why are we referring to MT3DMS in this question?

Q Because my question is just about how a higher biodegradation rate would affect PCE concentrations at TC -- at TT-26?

A It will reduce -- it will be reduced

compared to non-biodegraded -- -degraded PCE concentrations.

Q Would it be reduced compared to a -- using a lower biodegradation rate or would it be increased?

A If you change the parameters of a model, results will change.

Q Yeah. So if you put in a higher biodegradation rate --

A Yeah.

Q -- are you going to get lower PCE concentrations --

A That's correct.

Q -- at TT-26?

A That's correct.

Q And do you agree that lower PCE concentrations at TT-26 would result in lower PCE concentrations entering the Tarawa Terrace Water Treatment Plant?

A TT-26 is the main supplier of the contaminants, so if it is lowered, water treatment entry values will be lowered.

Q Okay.

MS. O'LEARY: Can we pull 28?

Actually, nevermind. We'll skip

that.

BY MS. O'LEARY:

Q When you were doing the TechFlowMP model, did you run it using other biodegradation rates besides the 0.00053?

A In different applications we have used many different parameters.

Q I mean in the Tarawa Terrace model.

A We have used what we have reported.

Q Okay. Thank --

A I don't remember that number out of my mind.

MS. O'LEARY: Then can we get 20- --

A Besides, remember that it's a calibration parameter.

BY MS. O'LEARY:

Q Uh-huh.

MS. BAUGHMAN: What exhibit number is this?

MS. O'LEARY: This is Exhibit 12.

(Whereupon, Government's Exhibit Aral 12, E-mail Chain, was marked for identification.)

BY MS. O'LEARY:

Q Okay. So Professor Aral, I'm handing you

Exhibit 12. It appears to be an e-mail -- a chain of e-mails.

I'd like to start at the one that starts in the middle of the first page where it says, "From Morris Maslia."

Do you see that?

A Yeah.

Q Okay. As you look at the part of this thread that starts at the second half of 12 at -- from Morris Maslia and continues onto the second page --

A Uh-huh.

Q It says, To Jason Sauntner (phonetic), Renee Sorresoto (phonetic), Amy Krueger (phonetic), to -- and e-mails, one of which is Mustafa.Aral@ce.gatech.edu?

A Uh-huh.

Q Is that your e-mail address?

A Yes.

Q And do you recall receiving this e-mail?

A Yes.

Q Okay. And did you discuss this e-mail with Morris Maslia ever?

A Discuss?

Q Yes.

A Yes.
Q Okay. Did you ever discuss it with Robert Faye, Rob Faye?
A Uh-huh. Oh, did I --
Q Did you discuss this --
A No.
Q No? Other than Morris Maslia, have you disc- -- did you ever discuss this e-mail with anyone else during the --
A No.
Q -- water modeling?
A No.
Q Okay. And the e-mail says in the first paragraph, "In this particular case, there is apparently a discrepancy on the value of the biodegradation rate for PCE 0.006 per day and 0.004 per day."
A Uh-huh.
Q And do you recall that discrepancy in biodegradation rate for PCE?
A This wasn't a discrepancy. This was a factual -- fact finding. We are using two different models.
Q Uh-huh.
A One is MT3DMS model and the other one is

using TechFlowMP model.

It is normal to two different models calibrate to two different constants which is differing from one another in the order of 0.0001 per day.

Q Uh-huh.

A And then the issue becomes the leader of the group, which is Morris Maslia --

Q Uh-huh.

A -- who wants to go with a uniform constant to be used in both models. And since these two numbers are not significantly different --

Q Uh-huh.

A -- from another, he made that decision that a mid-value should be used and I agreed with that.

I'm sure what -- I'm sure Bob Faye agreed with that as well.

Q Okay. So then in the e-mail, the -- in the numbered list number one says, "Fate and transport results provided using the MT3DMS model, we'll use a biodegradation rate of 0.0005 per day."

Do you agree that is what happened?

A Which one are you referring to?

MR. DEAN: He's read- -- she's

reading number one.

A Okay. Number one.

BY MS. O'LEARY:

Q Yeah.

A MT3DMS, I think it's using -- see, one number is -- ends with a four, the other one with a six, so the average was five. Could that be a --

Q No, my question is just: Is 0.0005 what was used in --

A Yeah.

Q -- MT3DMS?

A At the end, yes.

Q Okay.

A Of course.

Q And is that what was used in TechFlowMP as well?

A Exactly.

Q Okay. And if we are back in the first paragraph --

A Uh-huh.

Q -- of the part from Morris Maslia?

A Yeah.

Q So the part that begins the middle of page --

A Right.

Q -- one.

I think it's the second sentence says, "In this particular case, there is" -- excuse me, the sentence after that.

"There are two different levels of sophistication of models used, MT3DMS versus TechFlowMP" -- that's what you just --

A Exactly.

Q -- said basically; right?

A Yeah.

Q "And a lack of definitive data to compare modeling results attack -- against non-detects ranging from 2-micrograms per liter to 10 micrograms per liter in my opinion do not constitute a definitive standard by which to compare modeling results."

Do you agree that there was no definitive data on biodegradation rate?

MR. DEAN: Object to the form.

A I think that was a calibration parameter. That's what I said at the beginning.

BY MS. O'LEARY:

Q Does that --

A Even if we started with a certain estimate of a beginning point, it changes based on

calibration --

Q Okay.

A -- that we are doing.

Q Does that mean you would agree there was no definitive data on the biodegradation rate?

MR. DEAN: Object to the form of the question.

A As far as I know, whether there is field data existing or not, I cannot remember it right now --

BY MS. O'LEARY:

Q Okay.

A -- but probably not.

Q And then in the e-mail, at number three --

A Number three.

Q Yeah.

Actually, excuse me, number four.

Number four is, "If you wish to compare simulated results with measured samples including ND, you can do so in a table with four columns: sample location, date, measured value, simulated value detection limit. You are free to discuss in the text any implications you see from the data, but no other quantitative analyses are to be made. I'm

abandoning the use of the geometric bias as I have concluded we just do not have the data to justify its use."

And then right after it, it says, "Each report analysis will also provide a graphical comparison such -- such as the one I'm attaching as an example. I'm providing both tiff and jpeg file formats. In your respective graphs, you can plot simulated PCE versus time for a specific condition, e.g., calibrated early arrival, late arrival, etc., and overlay that with the measured data only."

A Uh-huh.

Q And what did you understand as the directions that Morris Maslia was giving in this e-mail bout not making quantitative comparisons using non-detects?

A I -- I will think from five, first of all, he's giving instructions to his team as to use a plot to --

Q Uh-huh.

A -- generate a plot to see how the two results are comparing with each other.

In terms of number four, what was your question in reference to that?

Q What were the directions --

A What direction --
Q -- you were receiving from this about using no quantitative comparisons with non-detects?
A I think he -- Morris is referring to some graphical analysis of the results with or without detects.
Other than that, I don't remember the content of this number four.
Q Okay. Did you understand number five in this list as prohibiting graphical displays that overlaid simulated --
A Yeah.
Q -- concentrations using different biodegradation rates?
A Right. He's asking different biodegradation rates and plotting the results to --
Q Wasn't he --
A -- compare.
Q Isn't he saying everyone is using 0.0005 as their biodegradation rate?
A No, before it gets to that stage --
Q Right.
A -- I think he was suggesting that his team to look into this.
Q How -- how is he suggesting that?

A He's suggesting to abandon -- abandon the other way of comparing the results, which is the -- I don't remember what that is now -- the -- some graphical geometric bias representation.

So he's suggesting to check the graphical comparison of simulated --

Q Uh-huh.

A -- results in chapter -- in item five and asks to see that comparison.

Q Right. So in five, the second sentence where it says, "In your respective graphs, you can plot simulated PCE versus time for a specific condition, e.g., calibrated early arrival, late arrival, etc." --

A Uh-huh.

Q -- "and overlay that with the measured data only."

A Yeah.

Q So does that mean you couldn't overlay that with, for example, data from runs of the simulation with --

A I --

Q -- two different --

A I --

Q -- biodegradation rates?

A I wouldn't answer that question because you are referring to what Morris has said in his position of the leader of this group and you are expecting me to interpret that. I wouldn't answer that question.

Q Did you make any graphical displays in reports you authored where you showed results of two different biodegradation rates --

A No.

Q -- in the simulated model?

A Even if we did, it didn't appear in a report. We may have looked at it.

Q Okay. And when you started calibrating the TechFlowMP model, did you start with the calibrated mass loading rate from MT3DMS, what they had used in that?

A Yeah, starting point was the same.

Q And did you use that starting point in both the unsaturated and saturated zones of TechFlow?

A We discharged that into the unsaturated zone, looked at the volatilization effects.

Q Uh-huh.

A We also considered the soil concentrations and the dilution from the soil

concentrations.

Q Uh-huh.

A That was available data for us, so that brought us to the starting point --

Q Uh-huh.

A -- of the calibration. So two -- two processes are different.

Q Sure. And when you started calibrating TechFlowMP, did you start with the biodegradation rate that had come from the calibration of the MT3DMS --

A Probably --

Q -- model?

A -- as a starting point, yes.

Q Sure. And how did the biodegradation rate change as you calibrated TechFlowMP?

A It must be in the tables that we have written in the reports.

Q Okay.

A I don't remember now.

Q You don't remember?

A Yeah.

Q Is biodegradation in the saturated zone anaerobically driven?

A Yeah.

Q Is biodegradation in the unsaturated zone aerobically driven?
A That's correct.
Q Okay. How do they compare? Is anaerobic biodegradation, for example, bigger or smaller than aerobic?
A Aerobic will be bigger --
Q And --
A -- volatilization.
Q Oh, I wanted to ask just specifically about biodegradation.
A Biodegradation.
Q So not losses, but -- but just biodegradation.
A Okay.
Q Is anaerobic -- anaerobically-driven or aerobically-driven biodegradation faster?
A You cannot say "driven" because it depends on the length of the unsaturated zone --
Q Uh-huh.
A -- and then the saturated zone. The -- this is a time-dependent process.
How long does it stay in the unsaturated zone is the driver actually. If you put a contaminant in the unsaturated zone, it passes

through in --

Q Uh-huh.

A -- seconds. It will be a different driving mechanism than if it stays there for days, months, etc. --

Q Right.

A -- because of the lower rates of migration. Of course that will be a different driver.

Q But what if it was in the two zones for the same amount of time? So if we were comparing apples to apples --

A Uh-huh.

Q -- if we were looking at the same amount of time in saturated and the same amount of time in unsaturated, and so we're looking at aerobically and anaerobically driven?

A Yeah.

Q Which one is faster?

A You are trying to speculate -- me to speculate on that. I --

Q But I'm wondering if you know?

A No, I'm not going to answer that because I have to run it and see it.

Q So you don't know, like, reference --

A No.

Q -- scale?

A I don't have a reference in my mind.

MS. O'LEARY: Okay. Can we look at 27, please?

(Whereupon, there was a discussion off the record.)

MS. BAUGHMAN: He means by that, be careful to let her finish her question before you answer.

COURT REPORTER: And the answer finish. There's a lot of overlap.

MS. O'LEARY: Yeah. You know what, we're actually not going to talk about 27.

BY MS. O'LEARY:

Q So moving on, I have questions --

THE WITNESS: What is 27?

MS. O'LEARY: It's an e-mail. But I'm not going to ask you anything about it, so I'm not going to introduce it.

BY MS. O'LEARY:

Q So I have questions for you now about pumping schedules at Tarawa Terrace, and I have just some questions for you about the -- the way water

supply wells work and are maintained.
So if I say where a well is screened, do you understand what I'm talking about?
A Uh-huh.
Q What is where a well is screened mean to you?
A That's where the water enters into the well hole.
Q Okay. And are you familiar with the concept of crusting on a screen from mineral deposits?
A It may happen, yes.
Q Okay. Does that cause blocking then of the screen?
A The capacity of the well reduces by that.
Q Is that, like, just phys- -- you know, basic physics? You get blocks --
A It's not physics.
Q -- from the minerals?
A It's a natural process.
Q Isn't everything physics in basis?
A Not really.
Q Not really?
Do you -- are you familiar with issue with wells being -- blockage of the screen from the

growth of algae or bacteria?
A Yeah.
Q And what -- well, you've already answered for the mineral crusting.
You said that that reduces well capacity; is that right?
A Right.
Q Does blockage of a screen from algae or bacteria growth also lessen well capacity?
A Of course, yes.
Q And how -- is it possible to try and fix mineral crusting that has happened on a -- on a well screen?
A You mean reduce that well capacity reduction?
Q Well --
A What --
Q -- reduce the crusting to try and increase capacity?
A I don't think so. I mean, you can reflush the well just to flush out the accumulated amounts in there and then restart pumping.
Q Okay.
A That's a way of --
Q And is --

A -- treating the problem.
Q Okay. So you can treat the problem by, you said, flushing?
A Yeah.
Q Okay. Can you -- what if you are dealing with -- or can you in- -- inject with, like, an acid to try and remove a mineral crust?
A That's not within my expertise --
Q Okay.
A -- area. That's a field study application.
Q And what about, like, the algae or bac- -- bacteria that are blocking a screen, can you try and fix that?
A That's also not in my expertise area.
Q Okay. If -- for the flushing that you mentioned --
A Yeah.
Q -- how long does that take to do?
A That's not in my expertise area.
Q Okay. How are the pumps in -- in water supply wells, how are they cooled?
A How are they what?
Q Cooled?
A Cooled?

Q Yeah. The pumps themselves?
A I have no idea. I mean, that's a field study.
Q Okay.
MS. O'LEARY: Can we pull number one, please?
(Whereupon, there was a discussion off the record.)
MS. O'LEARY: All right. This will be Government Exhibit 13, Professor Aral.
(Whereupon, Government's Exhibit Aral 13, Excerpt from Expert Panel Transcript from March 28, 2005, was marked for identification.)
THE WITNESS: Uh-huh.
BY MS. O'LEARY:
Q And this is an excerpt from an expert panel transcript from March 28th, 2005.
Are you familiar with this expert panel?
A Yeah. I have attended some, too; probably most of them.
Q Okay. And this panel was reviewing water modeling efforts of ATSDR at Camp Lejeune; right?
A That's what it says, yeah.
Q Okay. So can you go to -- it will be

marked as page 140?
A What?
Q It should say 140 in the top right corner.
A I have three pages in mine.
Q But one of them should be 140?
A Oh, okay.
MS. BAUGHMAN: That --
A Yeah, okay.
MS. O'LEARY: Yeah.
A Yeah.
BY MS. O'LEARY:
Q Okay. So on that page, starting at line nine, there's something from Dr. Walski.
Do you know who Dr. Walski is?
A Yeah, I know him.
Q Was he a member of this expert panel?
A Yes.
Q Okay. And there's also -- it mentions a Mr. Faye.
Is that the same Bob Faye?
A I assume so, yeah.
Q Okay. So at line nine, it says Dr. Walski said, "The fraction -- the fraction of the time was 26 on. Is it run, like, 80 percent of

the time or did it run 70 percent of time on average?"

And Mr. Faye said, "That I really don't know, Tom. All I know that it probably rotated."

And Dr. Walski said, "Okay. So --"

And Mr. Faye said, "And so didn't run a hundred percent of the time."

And you -- you mentioned that you had been at this panel; is that correct?

A That doesn't mean that I understand what they are talking about.

Q Well, would you -- you don't know what they are talking about?

A No, I don't know what they are talking about.

Q So you don't know if they are talking about how much TT-26 was run?

A No idea.

Q Okay. I think we looked at this earlier, but do you agree that the ATSDR model showed TT-26 as pumping unless there was a documented -- documentation that it was out of service?

A You mean actually it was pumping at a lower rate or at a period that it was modeled in the contaminant transport model?

Q I mean in the model, it was assumed to always be pumping, albeit at --
A Yeah, yeah, yeah.
Q -- varied amounts --
A Yeah, yeah.
Q -- unless it was documented that it wasn't pumping?
A Yeah, I understand what you are referring to.
Yes, the -- all the models -- all the pumping wells were assumed when they were running, pumping. Within a month --
Q Uh-huh.
A -- they were pumping throughout the month. If they are not -- if they are offline for three, four days --
Q Uh-huh.
A -- we didn't reflect that in the modeling analysis because we have a time period of one month sequentially to run one after the other.
We cannot get into a time interval and adjust pumping conditions. That's not possible.
Q Was it ever considered to try and reconstruct a maintenance schedule at the wells?
A Do I have information on that?

Q Right.
A No, I don't.
Q Okay. Do you agree that assuming that TT-26 was pumping, unless documents showed it wasn't, was a con- -- a more conservative assumption than, for example, assuming that it had a maintenance schedule?
MR. DEAN: Objection. Form. Assumes facts not in evidence.
MS. BAUGHMAN: Also, I think you need to speak louder. I don't think he's hearing you.
THE WITNESS: Yeah.
BY MS. O'LEARY:
Q Would you like me to repeat the question?
A Can you repeat the question, please?
Q Sure. Do you agree that assuming the TT-26 was pumping unless documents show that it wasn't was a more conservative assumption than modeling a maintenance schedule for TT-26?
A Conserv- --
MR. DEAN: Same objection.
A Conservative in what sense? Increased contaminant levels will be transferred to the water treatment plant --

BY MS. O'LEARY:

Q Right.

A -- is that what you are implying?

Q Right.

A Yes, that would be the case.

Q Okay. Okay. Can we go to chapter F again for a minute, ATSDR?

A I would like to be on record that I have not written this report, didn't run the simulations, and I'm not ready to answer the questions that may be coming up.

Q Okay. If we go -- I understand you did not write the chapter F.

If we go to page F 33 --

A Yes.

Q There's a table and then there's some text on the bottom right column. And in that text, it says -- kind of in the middle of the top paragraph, it says, "A geometric bias that compares."

Do you see that?

A Yeah.

Q Okay.

"A geometric bias that compares simulated and observed concentrations also was computed. An

inclusive bias was computed using all 19 paired data at water supply wells and equaled 5.9. A selected bias also was computed that excluded paired data at water supply well TT-23 and equaled 3.9. Both results indicate that simulated PCE concentrations moderately to substantially over-predicted observed concentrations at water supply wells."

So in reading that, do you understand this to mean that ATSDR calculated geometric bias for Tarawa Terrace in two ways, one that did not include non- -- which did not include non-detects?

A Yes.

Q Is that correct?

MR. DEAN: Object -- object to form.

A Yes.

BY MS. O'LEARY:

Q And then it -- they -- in that calculation of geometric bias for the Tarawa Terrace model, they did it in two ways: one where they included TT-23 and one where they did not?

A Uh-huh. Yes.

Q Do you know why the ATSDR calculated geometric bias with and without water supply well TT-23?

A Is it reported in this chapter F report,

that -- that statement?

Q I --

A Is it coming from this chapter?

Q I mean, I think -- I think I just read it, that it said --

MS. BAUGHMAN: He can't hear you, that's why.

MS. O'LEARY: Yeah.

A I -- I think you're looking at the different text than reading from the chapter. That's why I'm having problems. You are not reading from the chapter. You are reading from your notes.

BY MS. O'LEARY:

Q That's a snip of the same thing.

A Yeah, but I don't know that. It's -- it's your choice.

Q Right. Do you have F 30- -- page F 33 in front of you?

A Yeah, I do.

Q Okay. So in there, right, it says, "a selected bias also was computed that excluded paired data at water supply well TT-23"?

A Yes.

Q Okay. So my question is: Do you know why the ATSDR calculated a geometric bias with and

without TT-23?

A Probably the TC -- TT-23 was operating at a much shorter period of time. Whatever the data is coming from that, probably they don't want to include. I have no idea.

I think this report that you are referring to is not written by me. I have no idea what the -- the author wanted to say at that point in reference to these questions you are asking, so...

Q Okay. Do you agree that the Tarawa Terrace model moderately to substantially over-predicted observed concentrations at water supply wells?

A I think you should look at the results in an ensemble analysis of statistics rather than looking at point values of a well at a certain time, comparing it with the observations made at a certain time or at a similar time at the site.

So the analysis doesn't -- although ATSDR -- -DR provided all kinds of tables, the analysis was based on statistical analysis, not point-wise comparisons.

Q That statistical analysis is the geometric bias; right?

A No, the statistical analysis is based on the uncertainty analysis, whether the model falls into that range, whether the application is consistent with that uncertainty range, whether the sensitivity analysis is associated with that parameter reflects that --
Q Sure.
A -- in the model.
I mean, there are so many other aspects of uncertainty or statistical analysis rather than just looking at a scatter diagram that I am seeing here.
Q I understand that.
But isn't geometric bias part of that statistical --
MR. DEAN: Objection.
A Not necessarily.
MR. DEAN: Hold on. Hold on.
BY MS. O'LEARY:
Q -- analysis?
MR. DEAN: Hold on. Object to the form. Asked and answered.
MS. O'LEARY: Well, it wasn't answered.

BY MS. O'LEARY:
Q Sorry, what were you saying Professor Aral?
MR. DEAN: He told you he couldn't answer it.
MS. O'LEARY: He did not say that.
A Okay. I said it in record. I said it -- that.
I didn't write this report. I'm not answering any questions that is coming from somebody else's statements in this report.
BY MS. O'LEARY:
Q Yeah.
A And a scatter report -- a diagram like that may be used or may not be used. I'm not insisting that it should be used.
BY MS. O'LEARY:
Q So if we go to Exhibit 3, which is the chapter A report --
A Chapter A report. Okay.
Q -- to page 25?
A Page?
Q A 25.
A Okay.
Q Oh, actually, we can skip this. Never

mind. We don't have to go through that.

A Okay.

Q Okay. On -- back to chapter F page 33, so where we were.

A Okay. Chapter F.

Q Yeah, I want to talk to you --

A I repeat my on-the-record statement on that.

Q I just have questions about the data in this table. So Table F 13 --

A Page?

Page --

Q So we are on F 33.

A Okay. Okay.

Q So I just want to make sure I'm understanding the data in this table correctly.

A Uh-huh.

Q This is showing simulated -- so from the model -- PCE concentrations at water supply wells and then matching those up with observed concentrations of PCE in the water supply wells in Tarawa Terrace; is that correct?

A That's what it seems so.

Q Okay. And then it's showing in the column at the right, the calibration target range;

is that correct?
A Yeah.
Q So if I look at the section on TT-23, am I correct in -- in understanding this is showing that all 11 samples over-predicted PCE concentrations in the simulation versus the observed for TT-23?
A Repeat that question for --
Q Yeah.
A And loud, please?
Q For TT-23 in figure F 13 --
A Yes.
Q -- am I correct in understanding that the simulated PCE concentrations were higher for all 11 of the TT-23 entries?
A Yes. They were all higher, but they were in the calibration range as well.
Q Well, for TT-23, actually, didn't ten of 11 of them fail the calibration range?
A If I recall --
Q Not ten of 11, excuse me.
A I mean, the range goes from 11 to 117.
Q Yeah.
A Any way.
Q Okay.

A Yeah.
Q And if we look at TT-26 --
A Yes.
Q -- and am I correct that five over-predicted the PCE concentrations? Five of eight?
A Five zero eight?
Q Five of them were over- --
A Oh.
Q -- predictions of a total of eight; is that correct?
A Yeah.
Q And looks like several failed the calibration range --
MR. DEAN: Object.
BY MS. O'LEARY:
Q -- as well; is that correct?
MR. DEAN: Object to the form of the question.
A I -- I am on record saying that we don't look at calibration conditions based on one well at a time and compare the observed and the simulated values at one point in time. We look at the overall ensemble analysis --

BY MS. O'LEARY:

Q Yeah.

A -- of the statistics --

Q Yeah.

A -- of that representation.

So what you are doing right now is bringing back to me one data at a time comparison.

I would not do that.

Q But Professor Aral, I mean, you've already said -- agreed that -- earlier that this table is --

A That table is --

Q -- all of the values that were used --

A -- correct.

Q -- for calibration?

A That table is for you to look at and see the results.

Q Right.

A Analysis of the results is a total different story.

Q But --

A You do it statistically. You do it --

Q Yeah.

A -- in a different methodology.

Q Yeah. So this Table F 13, though, is --

is the comparison of all of the values --
A This is not --
Q -- used for calibration?
A It is not the comparison. It is for you to see what numbers are there. We are looking at or using in a statistical sense, probably they are going to refer to this table.
Q Uh-huh.
A These numbers or the statistics that we came up with is coming from this table. That's it.
Other than that, this table just for the information to be sent out to the other person to see what it is.
MS. O'LEARY: Can we go to 26?
A Page 26.
MR. DEAN: No.
BY MS. O'LEARY:
Q No, it's going to be a new exhibit.
A Okay.
Q You don't have it yet.
A Oh, okay.
Q That was for Ms. Horan to grab the right document?
A Okay.
(Whereupon, there was a discussion

off the record.)

MR. DEAN: Yeah, we should have put this on the record earlier. But when we are referring to an exhibit, the number we are using is the number we call out as the exhibit number in the deposition --

MS. O'LEARY: Yeah.

MR. DEAN: -- for the record.

MS. O'LEARY: Thank you.

(Whereupon, Government's Exhibit Aral 14, E-mail from Mustafa Aral to Jerome Ensminger, was marked for identification.)

BY MS. O'LEARY:

Q And so I've just handed Professor Aral what's marked as Government Exhibit -- is it 14?

MS. HORAN: Yup.

MS. O'LEARY: And then for the record, this is not a Bates-stamped copy, but the Bates is CLJA_ATSDR_ --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q Yeah.

-- -A_ATSDR_BOVE-0000018710 and then the

next page is -- ends in -11?

MS. BOLTON: I hate to do this, but can you just repeat just the final numbers --

MS. O'LEARY: Just the numbers?

MS. BOLTON: Yeah.

MS. O'LEARY: -18710 to -11 -- you know, to -11.

MS. BOLTON: Okay.

MS. BAUGHMAN: There were five zeros first?

MS. O'LEARY: Yes.

Okay.

BY MS. O'LEARY:

Q And Professor Aral, this looks to be an e-mail from you to Jerome Ensminger; is that correct?

A That's correct.

Q Do you recall this e-mail?

A Yeah. No, it's coming from me, definitely.

Q Okay. So -- and the subject --

A Okay.

Q -- is --

A Yeah, I remember this.

Q You do? Okay.
A Yeah.
Q It says the subject is testimony from John Nuckholls?
Who --
A Yes, yes, yes.
Q Who is John Nuckholls?
A One of the members of the expert panel.
Q The expert panel for 2005 or for --
A I don't --
Q -- 2009?
A One of them. I'm not sure.
Q Okay. And who is --
A I -- I think he was on the NRC report panel? Or did we have a panel? I'm not sure.
Q Okay.
A Anyway, he was on the NRC report.
Q And who is Jerome Ensminger?
Who is Jerome Ensminger?
A I think one of the plaintiffs; right?
Yeah.
Q You think he's a plaintiff? Okay.
This e-mail, though, is from -- it looks like it's from October 6th, 2009.
Do you have any reason to think that date

is incorrect?

A The date on it is -- seems to be correct; yeah.

Q Okay. And -- in October of 2009, how did you know Jerome Ensminger?

A I met him in probably 2005 in one of the ATSDR meetings. I told you that --

Q Yeah.

A -- at the beginning.

Q And at the beginning here, the first line, it says, "After a quick read, the following points strike me as not coming clean in his overall testimony."

A Yes.

Q Whose testimony are you talking about? Is that John Nuckolls' testimony?

A I think so, yeah.

Q And what was he testifying about?

A I think the expert panel was suggesting that ATSDR should use simpler models rather than complex models --

Q Uh-huh.

A -- to finish up the project and don't spend too much time on calibration.

MR. DEAN: Why don't you take time

and take a look at the e-mail.

THE WITNESS: I -- I know this e-mail.

MR. DEAN: Okay.

BY MS. O'LEARY:

Q Okay. So Professor Aral, I have a question for you on the paragraph that's numbered three.

A Yeah.

Q And it says, "His" -- I'm starting at the -- there's a line that says, "Having said that," kind of in the middle; do you see that?

A Yeah.

Q Okay. It says, "Having said that, in historical reconstruction methodology verifications are made by extending the historical predictions to the present day timeframe to see if the model that predicts the past ties to the present day conditions smoothly.

"In this verification process, the data used are the observed data in the present day. The verification in this case is the prediction of the present day with the use of the same model. This verification was done in the TT-modeling study and the results indicate that the models predicted the

past -- predicting the past was successfully predicting the present when extended to the present day within certain acceptable bounds of error."

And do you agree that in historical reconstruction methodology, verifications are made by -- can be made by extending the historical prediction to the present day timeframe to see if the model that predicts the past ties to the present day conditions smoothly?

A First of all, this modeling sequence that we are working with has four stages.

Q Uh-huh.

A Unstressed conditions in the ground waters, stressed conditions in the ground water.

For those two model applications, we have a lot of data. So those models are -- are calibrated, recalibrated looking at the data and so forth.

When we move to the third stage, which is the contaminant --

Q Uh-huh.

A -- transport model, there's no data, okay, at the field during the period of the historical --

Q Uh-huh.

A -- reconstruction.

However, having said that, if the first two models like stress/unstressed conditions in the aquifer is properly calibrated, most of the processes in the contaminant transport model is already available to us to run the model. Whether those -- those are advection conditions, diffusion conditions --

Q Uh-huh.

A -- it comes from the previous two models.

Q Sure, sure.

A In other words, if there's velocity, the velocity field is determined. If the velocity is determined, the diffusion constants are determined.

So what is missing -- what is missing is the retardation coefficients that we would use that we have discussed earlier or biodegradation rates that we have used earlier.

And I think there were several databases that was available to us towards the end of the period of the contaminant transport calibration. We have used that database. That's the 36 number that we were talking about. All of it was used to calibrate the contaminant transport analysis.

And when we come to the final stage, the

models one, two, three --
Q Uh-huh.
A -- was verified using the water treatment plant database, which is the present day conditions that I'm referring there in that e-mail. And that was used to verify the model.
Q Okay. I just want to make sure I understand which present day conditions.
Present day contaminant concentrations or --
A Present day contaminant concentrations, which is coming from in an independent data set, which is the water treatment plant data set which occurred probably after 1987 -- I'm not sure exactly -- but went onto '89 or something like that.
Q So when was this -- I'm not understanding why it's called "present day" if it's the 1980s and this is from 2009.
A Oh, we are predicting -- making predictions until 1987 or '89. That's all we are doing. Present day means to us 1987 or '89, not when this --
Q Oh --
A We are not referring to this 2009.
Q Okay. So do you mean to the -- the

present day is like the time of calibration data?

A Exactly.

Q Okay. I understand. Thank you.

A Yeah.

There's a -- okay. Go ahead.

(Whereupon, there was a discussion off the record.)

MS. O'LEARY: Do we need to take a break?

THE VIDEOGRAPHER: No. No. It's just that you dropped it.

MS. O'LEARY: Oh. Thanks.

And I'd like to move onto -- this will be chapter H, which is 62.

You can set aside 14.

(Whereupon, Government's Exhibit Aral 15, Tarawa Terrace Chapter H Report, was marked for identification.)

THE WITNESS: No, I need the other one.

MS. O'LEARY: You're right.

BY MS. O'LEARY:

Q Okay. So Professor Aral, you have now what's Government Exhibit 15. It's a copy of the Tarawa Terrace chapter H report.

Am I correct that you -- you did author this report?

A Yes.

Q All right. Can you go to page H 3?

A Yes.

Q And this is in a section called "A Review of ATSDR's Tarawa Terrace Study Background."

And the column on the left, the -- the last paragraph, it starts saying, "Using hydrogeologic data."

Do you see that?

A Yes.

Q Okay. Then about midway through that, there's a sentence that begins, "Due to."

Do you see that?

"Due to the nature"?

A Yeah.

Q Okay. So it says, "Due to the nature of historical reconstruction, uncertainties are associated with reconstructed information, which in turn cause uncertainties in resulting exposure analyses. Uncertainties in the exposure outcome can have a significant effect on the epidemiological study. In particular, the uncertainty caused by the groundwater pumping schedule used in the simulations

has been pointed out to be important. Therefore, in this study there's an evaluation of the variation in PCE concentrations and arrival times of the maximum contaminant level" -- skipping the parentheses -- "at water supply wells and the water treatment plant. The variation could be caused by changes in groundwater pumping rates at water supply wells."

So a few questions about that.

First, do you still agree with that?

A Yes, I do.

Q Okay. And who was it who pointed out that uncertainty caused by the groundwater pumping schedule is important?

A Expert panel members.

Q And why did they say it was important?

A Because changes in pumping rates obviously is going to -- going to effect the arrival times of contaminants to pumping wells.

Q Why does changes in pumping rates cause change in contaminant arrival levels?

A Because the driver is the contaminant -- pumping well rates for the plume migration.

Q Okay.

A If it changes, the plume will change.

Q Okay. And did you then do a study to

evaluate variation in PCE concentrations and the arrival times of MCLs at the water supply wells --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q Agree -- did you do a study to evaluate variation in PCE concentrations and arrival times at the MCL at water supply wells and the water treatment plant at Tarawa Terrace?

A That's right.

Q Okay. And if you go -- still in -- at the same Exhibit 15, the chapter H report -- can you go to --

A Chapter A?

Q H.

No, the same -- the same one, H.

MR. DEAN: H.

A Okay.

BY MS. O'LEARY:

Q Page H 1?

A Page one?

Q Yup.

A Yes.

Q Okay. So this is in -- labeled the abstract?

A Uh-huh.
Q And in the column on the right, the paragraph that starts, "During the historical reconstruction study."
It's kind of in the middle.
It says, "A major cause for and contribution to this uncertainty are the pumping schedules which are discussed in other report chapters. The focus of this chapter report, therefore, is on the uncertainty associated with pumping schedules. The study discussed in this chapter includes the development of a simulation and optimization procedure identified as PS Ops" --
Is that how you would say that?
A Yeah.
Q Yeah.
-- "which combines simulation models and optimization techniques to optimize pumping schedules for maximum or minimum contaminant concentrations at the water treatment plant. Based on optimized pumping schedules, variations of PCE concentration and the maximum contaminant level arrival time at water supply wells and the water treatment plant are evaluated. Results of this study indicate that variation of pumping schedules

may cause significant changes in the contaminant concentration levels and MCL arrival times at the water treatment plant."

Do you agree that a major cause for and contribution to uncertainty is the pumping schedule in Tarawa Terrace?

MR. DEAN: Object to the form.

A We have identified that major statement later in the chapter showing the uncertain -- uncertainty band --

BY MS. O'LEARY:

Q Uh-huh.

A -- changes when it is -- when the pumping schedules are optimized and different schedules are used in an application. So won't get stuck on that major word, just look at the statistics at the end.

Q And Professor Aral, we'll get there. I just -- do you disagree with what you wrote about the major --

A No, I don't --

Q -- cause --

A -- I don't disagree.

Q Okay. And PS Ops, I want to try and make sure I understand what it did.

So it does a simulation and optimization

for ranking the wells; is that correct?

A No, not ranking.

Q Well --

A It is -- it answers the following question quite clearly: How many different ways we can combine --

Q Uh-huh.

A -- all these pumping wells to meet the demand at Camp Lejeune site which will give us a totally different outcome than the mean --

Q Uh-huh.

A -- concentrations that we used to get with a fixed schedule.

Q Okay.

A That answers that question.

Q Yeah. And does it -- to do that, does it use a rank and assigned method to maximize or minimize or more optimize the arrival time of contaminants at water supply wells?

A It's -- it's emphasizing the arrival times. Is it going to come to the -- the contaminant is going to arrive --

Q Uh-huh.

A -- at a certain date earlier --

Q Sure.

A -- than what was predicted.
So it just combines all that -- those conditions in an optimization model.
Q Right. And is the way it does that with --
A Yeah.
Q -- a rank and assignment of the wells?
A Yeah, a rank and assignment is a solution process for an optimization --
Q Okay.
A -- model.
Q In -- was TT-26 ranked first for optimization among the Tarawa Terrace wells?
A I don't remember. Probably it --
(Whereupon, the court reporter requests clarification.)
BY MS. O'LEARY:
Q Was TT-26 ranked first for optimization among the Tarawa Terrace wells?
A I don't remember that.
Q Okay.
A It must be in the record of this report.
Q Can you go to H 23?
All right.
Actually, let's go on to H 29.

A Okay.
Q Looking at figure H 21.
Do you see figure H 21?
A Uh-huh.
Q Okay. Do you agree that figure H 21 shows the simulated PCE concentrations at the Tarawa Terrace Water Treatment Plant when the results of minimum schedule one are run on PS Ops in the dashed line?
A Uh-huh.
Q And do you agree that the minimum schedule one was to run a late PCE arrival time at the Tarawa Terrace Water Treatment Plant?
A Uh-huh.
Q Okay. And do you agree that the solid pink line is the calibrated Tarawa Terrace model?
A Yeah.
Q Okay. And so the -- what has -- sort of being modeled as happening for the dashed pink line is that that pumping of Tarawa Terrace 26, TT-26 was minimized as much as it could be and still meet demand at the water plant?
A Exactly.
Q Is that right? Okay.
A Exactly.

Q And so for the dashed line run, other than pumping, were all of the other parameters the same as in the calibrated model?

A Yes.

Q Okay. So is the difference in magnitude between the dashed pink line and the solid pink line representing the difference in PCE concentration from the calibrated model and what it could theoretically be minimized at?

A Theoretically is the right word.

Q Yeah.

A Okay.

Q Right. So -- would you -- but that would be theoretically possible?

A Impossible. Exactly.

Q Okay. And am I, in looking at figure H 21, understanding correctly that it shows that if TT-26 were minimized as much as were theoretically possible --

A Yes.

Q -- to meet demand, then the ATSDR's model would otherwise not simulate any PCE contamination in the water supplied by the Tarawa Terrace Water Treatment Plant between about January of 1960-something and January of 1972?

A That's correct.
Q Okay. And --
A But that's not theoretically possible. Because TT-26 is operating.
Q Sure. And I -- I want to go on next to H 38 --
A Okay.
Q -- and ask about another run that I think is -- is what you are talking about.
A Okay. That's fine.
Q So if we look at figure H 33 and --
A Figure on what page now?
Q H 38?
A H 38. Okay.
Q And then figure H 33?
A Okay.
Q And it says that it's the simulated PCE concentrations at the water treatment plant under the original schedule, solid line, minimum schedule one, and minimum schedule two, dashed lines.
A Uh-huh.
Q And so is minimum schedule two, is that where it's optimized to have a late PCE arrival time with the restriction that TT-26 had to pump at least 25 percent --

A Yes.
Q -- of its pumping --
A Yes.
Q -- capacity?
A Exactly.
Q And why did you do the minimum schedule two run where TT-26 has to pump at least 25 percent of the time?
A Well, because that was more realistic in reference to what we were observing as how TT-26 contributed to water treatment --
Q Okay.
A -- plant.
Q So more realistic in how it was --
A More realistic.
Q -- pumping?
A Yeah.
Q Okay. And in looking at figure H 33, is the -- the dashed line that has closer together dashes, is that the simulated PCE levels at the water treatment plant when that minimum schedule two is on? So the one where TT-26 is pumping at -- at -- at least 25 percent --
A Right.
Q -- capacity?

A If you extend that -- if you can see that dashed line extended to 1985, that will be the water treatment plant.

Q Okay. And then is it true then that the difference between the tightly dashed line, the minimum schedule two line, and the solid dashed line, that's the difference in PCE concentration from the calibrated model and then the minimum schedule two where --

A TT- --

Q TT-- --

A -- twenty-six.

Q -- twenty-six is minimized but not below 25 percent?

A Right. Exactly.

Q Okay. So this analysis of these minimum pumping schedules is in chapter H.

And my question is: Why is this pumping uncertainty analysis in chapter H and not chapter I where the other uncertainty analyses are?

A Because we didn't look at the variations of the other parameters in this uncertainty analysis. We only looked at the pumping schedule uncertain.

Q In chapter I where the --

MS. O'LEARY: We can get 63.
We don't have it yet.

THE WITNESS: Oh, okay.

MS. O'LEARY: I'm getting it.
Sorry.

THE WITNESS: Uh-huh.

(Whereupon, Government's Exhibit Aral 16, Chapter I Report, was marked for identification.)

BY MS. O'LEARY:

Q All right. This will be Exhibit -- Government Exhibit 16, so the chapter I report.
So in chapter I, I want to go to page I 55?

A Yes.

Q Okay. There's a figure I 29; is that what you're seeing?

A Yeah.

Q Okay. So I 29's label says it's the "concentrations of PCE in finished water at the water treatment plant derived from scenario one where pumping uncertainty was excluded and scenario two where pumping uncertainty was included in the probabilistic analysis using Monte Carlo as simulation at Tarawa Terrace."

So the -- the Monte Carlo simulation, was that a probabilistic --
A Yes.
Q -- evaluation of uncertainty?
A Yes.
Q Okay. And to do that in the Monte Carlo simulations, did that involve model -- varying model input parameters?
A Yeah.
Q Okay. And so --
A I have a diagram to show which parameters.
Q In your report?
A In the uncertainty analysis in my experts report.
Q Yeah. And for what figure I 29 shows in terms of the pumping scenario -- from scenario one and two with pumping uncertainty included and not included, that pumping variation, that's different pumping variation than what was in chapter H; correct?
A In what sense?
Q Like in, like, scenario one and scenario two for pumping --
A I think you are seeing the scenario

two --

Q Well --

A No. No. No. That's not correct.

This result now that you are seeing in this chapter --

Q In chapter I?

A In chapter I.

-- includes uncertainty analysis of pumping schedule variations --

Q Uh-huh.

A -- including uncertainty analysis of pump -- parameter conditions together.

Q Right. But the pumping variation in chapter I is not the same pumping variation --

A No.

Q -- of chapter H; right?

A No. No, no, it's not.

Q Okay.

A We are looking at maximum/minimum conditions that we looked at earlier. This -- this is the pumping uncertainty standard variations with respect to statistical analysis --

Q Okay.

A -- that is reasonably what it is at the site.

Q And for the -- the variation in pumping that went into chapter I, that range, how was that range of parameters inputs selected?
A Okay. That's a question. I have to go back and read that. I don't have an answer on top of my head.
I think we looked at the distributions of possible pumping rate schedule changes. I mean, I have to read this whole report.
I -- I don't have an answer to that --
Q Okay.
A -- right away.
Q But it's different than chapter H?
A It is different, yeah.
Q And were the ranges of parameter inputs for the chapter I Monte Carlo simulations, were those the theoretical limits of parameters?
A As far as we know from the site data, I think they were.
Q In how -- in what way were -- would they be the theoretical limits?
A Not theoretical. Whatever we have observed at the site in terms of hydraulic conductivities, in terms of other parameters, we came up with that range in uncertainty analysis as

the range to be used.
Q Okay. So does that mean then that for the Monte Carlo simulations, did the Monte Carlo simulations explore the theoretical range of possible solutions --
A Yes.
Q -- at Tarawa Terrace?
A We put probability distribution on a parameter within the range that it is defined. Monte Carlo analysis picks up data from that probability density function --
Q Sure.
A -- combines it with another parameter for its -- or from its probability density function, combines all that into the model --
Q Uh-huh.
A -- runs the model. You get one point on the slide.
Q But did the Monte Carlo simulation in- -- involve simulating every possible combination of parameters --
A No.
Q -- within the --
A That would have --
Q -- ranges selected?

A -- been a hundred years to run.
Q Okay. But then how is it -- how is the Monte Carlo simulation then showing the theoretical range --
A Okay.
Q -- of possible solutions?
A There's a method for that. That -- in hyperacute modeling.
I think we ended up using only 810 simulations from the PDFs database. And then I believe some of them dried out some of the wells. I believe it was 300 or so.
So what is remaining for us to analyze is about 520 or so database to construct this uncertainty analysis.
Q Yeah. But, I mean, that would mean then you are not looking at the theoretical range of --
MR. DEAN: Object to the form.
A No.
BY MS. O'LEARY:
Q -- possible solutions?
A That -- that doesn't mean that.
The question here to ask is how many Monte Carlo simulations --
Q Uh-huh.

A -- is required to run a reasonable uncertainty analysis. In a case like this, the answer is 400.

Q But that's not my question.

A Yeah.

Q Not what's reasonable.

My question is whether the Monte Carlo simulation that was run for Tarawa Terrace explored the -- like, the universe of possible solutions?

A The universe of the possible situations that was bound by the database that we chose for each parameter.

Q Okay. And but that -- those bounds of parameters were not, like, the theoretical limits; those were selected from the site -- available site data?

A Yeah.

Q Okay.

A It is based on site data.

Q And then within the Monte Carlo simulation, it didn't -- it didn't test every possible combination of parameters?

A It wouldn't be a Monte Carlo analysis then.

Q Well, it would be another way of --

A It would be --
Q -- looking at uncertainty?
A -- running all the direct simulations for all the points on the PDF. That's an impossible act.
Q And so that's not what was done?
A How can we do it?
Q Okay. And so in figure I 29 --
A Uh-huh.
Q -- there's --
A Yeah.
Q -- areas between -- both for scenario one and scenario two, the --
A Yeah.
Q -- you know, pumping variation and no pumping variation.
There's an area between lines that says it's the range of concentrations representing 95 percent of Monte Carlo simulations.
Do you agree that that range representing 95 percent of Monte Carlo simulations for Tarawa Terrace is not equivalent to the 95 percent range of the universe of possible --
MR. DEAN: Object.

BY MS. O'LEARY:

Q -- mean historical contaminant concentrations --

MR. DEAN: Object --

MS. O'LEARY: -- at Tarawa Terrace.

MR. DEAN: Object to the form of the question.

A Okay. 95 percent within the bound of the PDF distribution that we have selected for that parameter is identified or selected by the method itself randomly. We are not assigning select this, select that, select -- no.

Randomly -- random -- random numbers are generated. Based on those random numbers, it goes and picks up some number some -- from some PDF distribution --

BY MS. O'LEARY:

Q Uh-huh.

A -- for some parameter matches up with another parameter PDF distribution number, puts them into the model, and then --

Q Yeah.

A -- then runs it.

Q Do you agree that the -- the total size of the universe of possible solutions to modeling

Tarawa Terrace is unknown?

A What do you mean by "universe"?

Q Like all of the ways that the model could have been set up, that all of the ways that the contaminants could have moved through time, that the size of that range is unknown?

MR. DEAN: Object to the form.

A So you are referring to that -- that statement to me means, Don't do a statistical analysis and just do all the possible points on a PDF function --

BY MS. O'LEARY:

Q Well --

A -- and run it through.

Q I think what I'm more trying to understand is how the Monte Carlo simulation and the confidence interval --

A Okay.

Q -- that's reported relates to the theoretical range --

A Okay.

Q -- of possible outcomes.

A I think the best way to answer is if you have a sample of 500 data point matchings from different PDF functions, the representation of that

outcome is 98.5 percent accurate with respect to the mean value that we have generated as a deterministic result.

Q But that's only within the parameter ranges that you evaluated; right?

A Well, it's the beginning of analysis. You cannot go back and question --

Q Yeah.

A -- what you started with.

Q Well, my question is about how that relates to not within the modeling world, but how that relates to what could have been possible in the real world?

MR. DEAN: Object to the form of the question.

A Okay. What you are referring to is you have not selected the proper bounds on the parameters that you inputted PDF functions. That's what you are telling me.

BY MS. O'LEARY:

Q Well, no.

A The universe means --

Q I'm asking how they relate?

A -- that to me.

Q No, I mean theoretically in the real

world, not in the parameter range that you select.

MR. DEAN: Object to the form of the question. There's no such thing as theoretically in the real world.

A Look, we decided to statist- -- to do a statistical analysis. The statistical analysis follows a standard procedure to be used in an application. And that standard -- standard -- standard procedure is very simple, it's not complex.

BY MS. O'LEARY:

Q Uh-huh.

A It's very simple. It says, Give us the bounds of each parameter you think represents the conditions at the site.

Q Uh-huh.

A That's number one.

Then fit a probability density function within that range to represent the distribution of that parameter. That represents the conditions at the site.

The third stage. You go and throw dice or -- or flip a coin, it becomes a random number. It goes back into the PDF function, picks one number out of that and another number out of the other PDF, combines that. That's the statistical procedure.

You cannot -- once you decide to do this, you cannot divert and ask questions. What you are doing, is it representing the universe?

No, we are modeling the universe.

MS. O'LEARY: And I can go on to 42.

This will be a Hadnot Point --

A Okay.

MS. O'LEARY: -- summary.

Actually, do you have that already?

MS. BAUGHMAN: You did mark a summary --

MS. O'LEARY: Yeah, I think we marked -- let me find that one.

MS. HORAN: I have it as Exhibit 4.

MS. O'LEARY: Exhibit 4 should be hopefully in this stack here.

THE WITNESS: Okay.

Okay.

BY MS. O'LEARY:

Q There you go. It's rather thick.

A Chapter A.

Q Yeah, chapter A and then just to page iii in the forward?

A Four --

Q Iii.

A Iii. Okay.
Q Oh, in the forward, yeah.
A Wait a minute.
Are there two reports in here or --
Q No, it should be right near the beginning, Professor Aral.
I think it might have been before that.
A Iii. Okay. I see it. Forward.
Q Okay. Yeah. So it says in the first paragraph, "The Agency for Toxic Substances and Disease Registry, an agency of the U.S. Department of Health and Human Services, is conducting epidemiological studies to evaluate" --
A Yeah, we read this earlier.
Q Well, we read it in Tarawa Terrace.
A Oh, did we?
Q Yeah.
A This is what?
Q This is Hadnot Point.
A Oh, really? Okay.
Q Yeah.
A Okay. Good.
Q So -- "was conducting epidemiological studies to evaluate the potential for health effects from exposure to volatile organic compounds such as

tetrachloroethylene, trichloroethylene, and benzene in drinking finished water at U.S. Marine Corp Base Camp Lejeune, North Carolina. Historical exposure data needed for the epidemiological studies are limited. To obtain estimates of historical exposures, ATSDR is using" --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q -- "ATSDR is using water modeling techniques" --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

-- "data needed for the epidemiological studies are limited. To obtain estimates of historical exposures, ATSDR is using water modeling techniques and the process of historical reconstruction to quantify concentrations of particular contaminants in finished water and to compute the level and duration of human exposure to contaminated drinking water."

Were you aware when you were working on the Hadnot Point water -- water modeling of this purpose stated in the forward?

A I wasn't aware of the details of this purpose, but I was aware of the fact that this study was going to be followed by an epi study.
Q An epidemiology --
A Yeah.
Q -- study?
Okay. And still in the Hadnot Point chapter A, so Exhibit 4, if you could go to page A 62?
A Okay.
Yes.
Q And the top left, the first paragraph of A 62 where it begins, "Using reconstructed"?
Do you see that?
A A 6 --
Q I think you're --
A Sixty-two.
Q -- on the right page.
A 62, yeah. On the top left?
A Yeah.
Q Okay. So it says, "Using reconstructed simulated water supply well concentrations previously discussed, monthly mean concentrations of PCE, TCE, 1,2-TDCE, VC, and benzene were estimated for finished water at the Hadnot Point water

treatment plant. These estimates were computed using a materials mass balance model simple mixing to compute the flow-weighed mean concentrations of VOCs as described earlier in this section on computation of contaminated finished water concentrations."

So does -- is it the case that the ATSDR only modeled at Hadnot Point Holcomb Boulevard PCE, TCE, 1,2-TDCE, VC, and benzene?

A What's the last one?

Q Benzene?

A Oh, benzene? Yes.

Q Okay. And you aren't offering opinions about historical concentrations of any other compounds at the Hadnot Point or Holcomb Boulevard areas.

A Not --

Q Is that correct?

MR. DEAN: Object to the form.

BY MS. O'LEARY:

Q Is that correct?

A Not other than these listed.

Q So --

A Yeah.

Q -- trichloroethylene,

tetrachloroethylene --
A Yeah.
Q -- dichloroethylene, vinyl chloride, and benzene?
A Yes.
Q Okay. And in that same page where it says, "These estimates were" -- so still this is A 62?
A Okay.
Q It said, "These estimates were computed using a materials mass balance model simple mixing."
Do you agree that -- that Hadnot Point model also did not include a calculation for loss of contaminants in the water treatment plant?
A As far as our analysis go, no.
Q What do you mean "our analysis"?
A I mean the water -- water modeling analysis --
Q Oh, okay.
A -- that we have done. Yeah.
Q So water modeling did not involve a calculation for contaminant losses in the water --
A That's --
Q -- treatment plant?
A -- correct.

Q And we are going to set aside this one for a bit.

MS. O'LEARY: And can we get -- this will be 39.

There we go.

THE WITNESS: Are we done with this?

MS. O'LEARY: We are done with that one, yes.

THE WITNESS: Okay.

(Whereupon, Government's Exhibit Aral 17, Chapter A Supplement Two for Hadnot Point, was marked for identification.)

BY MS. O'LEARY:

Q Thank you.

So Professor Aral, this is Government Exhibit 17?

A Okay.

Q Professor Aral, this looks like a copy of the chapter A supplement two for Hadnot Point.

Is that what it looks like to you?

A Yeah.

Q And am I correct in understanding that you are an author on this --

A Yes.

Q -- chapter?

All right. I have a few quick questions for you --

A Uh-huh.

Q -- on page S2.74?

A Yes.

Q Okay. And -- I'm on the wrong page. There we go.

I want to look at figure S2.99; do you see that figure?

A 299, yes.

Q Okay. It says, "Estimated monthly operating days for well HP-634."

Do you agree that figure S2.99 shows the number of days per month that HP-634 was modeled as pumping in the ATSDR's calibrated model for Hadnot Point?

A As a outcome of the modeling sequence that we have used, that seems to be the case. But it's not daily. I think it's monthly.

Q Sure. So --

A Okay.

Q -- so the -- so it -- well, the scale on the left says days?

A Is it?

Oh, day.
No, number of days --
Q So then the line would represent total number of days per month.
So the time scale would be monthly?
A Yes.
Q And then --
A Yes.
Q -- it's showing its days?
A Yes.
Q Okay.
A Monthly versus days, yeah.
Q And do you agree that figure S 2.99 shows that in the calibrated HP model, HP-634 was not modeled as pumping after January of 1985?
A Yes.
Q Okay. All right. That's my only question on that. But we'll stay in -- well, maybe. We are going to --
MR. DEAN: Can we take a break?
MS. O'LEARY: Sure.
MR. DEAN: Are you okay with that?
MS. O'LEARY: Yeah, that's fine.
THE VIDEOGRAPHER: The time right now is 2:59 p.m. We are off the record.

(Whereupon, there was a recess taken from 2:59 p.m. to 3:12 p.m.)

THE VIDEOGRAPHER: Time right now is 3:12 p.m. We are back on the record.

BY MS. O'LEARY:

Q Professor Aral, I have a few more questions for you in the Hadnot Point supplement two.

So this is Exhibit 17 -- Government 17?

A Okay.

Q And could you go to page S 2.2.

All right?

A Uh-huh.

Q I think that is one --

A Two.two -- oh, 2.4, I'm sorry.

Yeah.

Q Okay. So in the data availability data sources section, so the column on the right?

A Uh-huh.

Q It says, "Four types of data sources pertinent to water supply well operational records and water treatment plant raw water records are used in the supplement. These are: one, daily operational records for January 1998 to June 2008" -- and skipping the parenthesis --

"number two, Camp Lejeune historic drinking water consolidated document repository records; three, Camp Lejeune water documents; and four, U.S. geological survey well inventory documents."

A Uh-huh.

Q "Using these data sources, operational chronologies for 96 wells supplying groundwater, raw water to the Hadnot Point Water Treatment Plant and Holcomb Boulevard Water Treatment Plant were developed."

And so Professor Aral, why did operational chronologies for these 96 wells have to be developed?

A I was not involved in data collection, so I have no idea what this is telling us about.

Q Okay. Then we can go on to page S2.12.

And so just to start out, were operational histories reconstructed for the Hadnot Point water supply wells?

A Can you repeat that question, louder please?

Q Sure. Were operational histories reconstructed for the Hadnot Point water supply wells?

A I don't -- I don't remember that.

Q Okay. So on S2.12 in that first paragraph on the top left?

A Uh-huh.

Q It says, "Similar to the training" -- or after that, actually, a couple sentences.

It says, "Because some wells did not physically exist during the training period, surrogate wells were selected to represent these untrained wells."

So do you know what the training period is a reference to?

A I have to read this paragraph here.

Q Sure.

A "Similar to..."

Looks like they are trying to come up with a operational well history on the site as to when they were operated, when they were not operating. That's what this refers to.

Q Okay.

A Yeah.

Q Were you involved in a -- like, a training process for the Hadnot Point wells?

A No.

Q Okay. And then we can set aside this supplement --

A Okay.
Q -- two from Hadnot Point and go back to Exhibit 4, the Hadnot Point chapter A, to page 80 -- 80 -- excuse me -- A 84?
A Okay.
Q And so Professor Aral, A 84, this section is titled "Trichloroethylene Source Release Date Sensitivity Analysis."
Were you involved in the trichloroethylene source release date sensitivity analysis at Hadnot Point?
A No, I don't think so.
Q You were not?
A I don't remember that.
I mean, which area is this on Hadnot Point --
Q Hadnot Point --
A -- industrial area or the landfill area or which one?
Q So the source release date sensitivity analysis --
A Yeah.
Q -- I think it involved both?
A Both?
Q Yeah.

A No, I'm -- I don't remember this.
Q Okay. Can you take a look at the next page, A 85?
A Uh-huh.
Q There's a figure, A 37 -- actually, sorry. Just a minute.
I'll come back to that. I think we can set aside actually the chapter A for Hadnot Point.
MS. O'LEARY: And can we get -- it will be 40. It will be Hadnot Point supplement six.
MS. HORAN: I believe that's Exhibit 11.
MS. O'LEARY: That's Exhibit 11. Okay.
BY MS. O'LEARY:
Q Professor Aral, could you grab Exhibit 11?
A Exhibit 11?
MS. O'LEARY: Oh, yes. There it is.
THE WITNESS: Yeah. It's there.
BY MS. O'LEARY:
Q Okay. So on Exhibit 11, page S6.17.
A Again, this is a supplement that I wasn't an author on.

Q No?

Okay.

A Okay.

Q So actually, going one page -- rather than S6.17, S6.16. So just the page before.

Do you see a table S6.5?

A Okay.

Q And it says it's calibrated contaminant fate transport model parameter values used to describe contaminant sources in the Hadnot Point industrial area and Hadnot Point landfill area, Hadnot Point Holcomb Boulevard study area.

Were you involved in selecting the calibrated contaminant, like, mass loading rates?

A Which is presented in this report?

Q No. In general, at Hadnot Point?

A But we are looking at this report.

Is that in this report? That's what I'm asking. Is that database is in this report?

If it is not, I would like to go back to the database that was used later on in another study and see if I was the author on that.

Q Oh, so -- so you're saying you're not sure if you were involved in --

A I'm involved --

Q -- that?
A -- in it. But I'm looking at a table --
Q Uh-huh.
A -- which I have not prepared.
And I'm not ready to answer questions on it, because I was not involved in writing this report.
Q Okay. So, I -- I mean, I think this is the report where these contaminant mass loading rates are reported in the Hadnot Point reports.
A But some other group did it. There's a different group in every task, and they write whatever they write.
If I have used it in another study related to this industrial area or landfill area, let's go to that report and discuss it there.
Q Well, I guess that's what I'm asking you.
Did you use -- in the areas you worked on, did you use the --
A I would --
Q -- the fate --
A -- like to --
Q -- and transport --
A -- go back --
Q -- buckles?

A -- to the report that I wrote, listed these numbers. Then, I would say, Yes, I have used it.

It may be totally "inrelevant" -- irrelevant to my application. I don't know.

BY MS. O'LEARY:

Q Okay.

MS. O'LEARY: Can we get -- this will be -- we can set aside 11, Exhibit 11.

And can we get 25?

THE WITNESS: Okay.

MS. O'LEARY: You don't have it yet, Professor Aral.

THE WITNESS: Okay.

MS. O'LEARY: It will end up being, I think, Government Exhibit 18.

THE WITNESS: Okay.

(Whereupon, Government's Exhibit Aral 18, E-mail String Between Robert Faye and Mustafa Mehmet Aral, was marked for identification.)

MS. O'LEARY: Yup.

And I have some questions about calibration of Hadnot Point.

THE WITNESS: Okay.
MS. O'LEARY: There you go.
THE WITNESS: Okay.
BY MS. O'LEARY:
Q Professor Aral, Government Exhibit 18 appears to be an e-mail from you to Robert Faye from September 21st of 2011.
Do you recognize this e-mail?
A Yeah. It's from me.
Q Do you remember it?
MS. BAUGHMAN: You should take your time to read it first.
THE WITNESS: Yeah. I'm reading it.
BY MS. O'LEARY:
Q Professor Aral, are you -- what page are you on reading?
A I'm reading the whole e-mail sequence.
Q Okay. I thought you had mentioned that you did re- -- you did recognize this e-mail?
MR. DEAN: He did, but we --
A Yeah. But this was ten -- how many years ago?
BY MS. O'LEARY:
Q Okay. Would you like --
A I have to read the whole thing to

answer --

Q Yeah. Would --

A -- questions.

Q -- you like to go off record so you can read it?

And we can --

MR. DEAN: No.

BY MS. O'LEARY:

Q -- come back on record when you're ready?

MR. DEAN: No. Keep the record rolling. But --

MS. O'LEARY: No. We --

MR. DEAN: -- if it's --

MS. O'LEARY: -- can -- we can take a break --

MR. DEAN: No. It's --

MS. O'LEARY: -- if you need to read all of the pages.

So let's go off the --

MR. DEAN: No. No.

MS. O'LEARY: -- record, please.

MR. DEAN: Absolutely do not stop the videotape rolling. You can stop transcribing if you'd like.

But he's going to continue to read

it. You're the one that asked him a- -- about the e-mail. He has a right to read it.

There's nothing that suggests that we have to turn off the record every time you present him with an exhibit, which he has a right --

MS. O'LEARY: Yes. But --

MR. DEAN: -- to read --

MS. O'LEARY: -- he's -- he's --

MR. DEAN: -- and stop --

MS. O'LEARY: -- already said --

MR. DEAN: -- the transcript.

MS. O'LEARY: -- he recognized the e-mail.

So Professor Aral, I'm fine to go off record for you to read every word --

MR. DEAN: No.

MS. O'LEARY: -- and not on the record.

So are you ready to proceed --

MR. DEAN: He can --

MS. O'LEARY: -- or not?

MR. DEAN: -- keep reading, but we'll keep the record running.

A Can you tell me which part of this --
BY MS. O'LEARY:
Q Sure.
A -- your question --
Q Yeah?
A -- is all about?
Q Sure.
A I can have a focus on that.
Q Yeah. So I have questions for you about page one and page two.
A Okay. So what is your question?
Q So on page two, there's an e-mail from you to Robert Faye that's dated September 20th --
A Uh-huh.
Q -- 2011.
The subject says, Re: TCE landfill data. And in the paragraph there, it's addressed to Bob.
Is that to Robert Faye?
A That's to Bob -- yeah. Bob Faye.
Q Okay. So, kind of, in the middle, there's a sentence that begins, Here, I'm not referring to CT application we did two years ago.
Do you see that?
A Yeah.
Q And it says, We did -- we did what we had

to do. The outcome of our assumption seems to yield pretty good answers, given what we did not know or how little we know at the time and how little we included in our overall analysis to come to that conclusion. I am interested in hearing your thoughts on the calibration targets for GW fate and transport models.

So just background, "CT" is that control theory application?

A Yeah.

Q And when you say "GW," is that groundwater?

A GW, groundwater.

MS. BAUGHMAN: Is -- isn't -- isn't "CT" calibration target?

THE WITNESS: Well, it can be that, too, referring to calibration targets. Yeah.

MS. BAUGHMAN: Because the --

THE WITNESS: That's right.

MS. BAUGHMAN: -- prior e-mail --

THE WITNESS: That's correct.

MS. BAUGHMAN: -- is all about that.

THE WITNESS: It's calibration --

BY MS. O'LEARY:
Q All right. This is about tal- -- calibration targets?
A Correct.
Q You are not referring to calibration target application you did two years ago?
A Calibration targets -- probably, I'm referring to Tarawa Terrace.
MR. DEAN: Object to the form of the question.
MS. BAUGHMAN: I -- I really think you need to read the prior e-mail on -- on -- from Bob Faye to you right before this e-mail, or you might understand the context.
BY MS. O'LEARY:
Q Well, Professor, hadn't you already read page three?
A The first e-mail is from me to Bob.
Q Uh-huh.
A Apparently, we had a meeting or a conversation on -- or during which I have asked him some calibration targets that he has or he may not have in his mind.
So that's the start of the discussion.

He answers --

MS. BAUGHMAN: Wait. Wait. Wait.

What -- you've got to -- she needs to ask you a question. Okay?

You're just -- you're just explaining the e-mail.

Wait for a question.

BY MS. O'LEARY:

Q Pro- --

MS. BAUGHMAN: But make sure you've read the whole --

BY MS. O'LEARY:

Q So Pro- --

MS. BAUGHMAN: -- chain first.

BY MS. O'LEARY:

Q Professor Aral, let me just ask my specific questions, and this --

A Please.

Q -- might go better.

So do you agree that this e-mail --

A And loud --

Q -- thread -- the --

A -- please.

Q -- one -- yeah.

Do you agree that that e-mail on

September 20th, 2011, from you to Robert Faye -- so the one on page two --
A (The witness nods head.)
Q -- that this e-mail is about calibration targets for TCE at HP651?
A In page two?
Q Yes.
A Uh-huh.
Q You agree?
MR. DEAN: Object to the form of the question.
A Can you repeat that --
BY MS. O'LEARY:
Q Yeah.
A -- what are --
Q You agree that e-mail is about -- about calibration targets for TCE at Hadnot -- HP651, the well?
A Okay. Which page is this that you're --
Q Two.
A -- reading?
Q Right here, in the --
A Second page?
Q Yes.
A From me to Bob?

Q That's right.
A Okay.
Okay. What is your question again?
Q All right. When you said, We did what we had to do, what did you mean?
What is it that you had --
A We change --
Q -- to do?
A -- we chose a proper calibration target, and we went about applying it.
Q Okay. And you said, The outcome of our assumptions seems to yield pretty good answers given that we did not know or how little we knew at the time and how little we included in our overall analysis to come to that conclusion.
What is -- what do you mean by the "outcome of our assumptions"?
A I think we made some assumptions to choose a calibration target, and it worked out in the final analysis in the sense that our modeling application yielded good results. And I think I'm referring to Tarawa Terrace there.
Q Uh-huh.
A So I'm suggesting, maybe, why don't we use the same approach, come up with a proper

calibration target, and go at it?

Q And the way you did it at Tarawa --

A Right.

Q -- Terrace, do it at Hadnot Point?

A Right.

Q Okay. And then, on page one of this e-mail -- so the page one of Exhibit 18 --

A Uh-huh.

Q -- in the e-mail from Robert Faye to you and others that's dated September 20th, 2011, do you see that one?

A Yup.

Q It says, Hi, folks. First, it seems to me, the overall model calibration strategy has always been and should be to apply defensible methods to simulate field observations.

Second, our models only grossly approximate real-world physics, chemistry, and biology.

Third, the feed -- field data represent a snapshot in time during one day, whereas our model simulate average monthly conditions. It seems to me that an effective and a ap- -- appropriate approach to model calibration must integrate these realities into the -- into a practical strategy.

And then, there's one more sentence.

But do you agree with what Robert Faye said, that the ATSDR's HP models only grossly approximate real-world physics, chemistry, and biology?

MR. DEAN: Object to the form of the question.

A No.

I think what he's trying to do, if I -- I don't recall -- recall this e-mail sequence. But he may be suggesting different calibration targets than what we have used at Tarawa Terrace.

And probably, I'm insisting that what we did at Tara- -- Tarawa Terrace worked for us. So let's continue with the same approach, same targets, and it will work for this case, as well.

BY MS. O'LEARY:

Q Why is it that the models are not grossly approximating real-world physics, chemistry, and biology?

A Well --

MR. DEAN: Object to the form of the question.

That's not his e-mail.

THE WITNESS: Yeah.

MR. DEAN: That's Bob Faye's e-mail.
THE WITNESS: Yeah.
MS. O'LEARY: That I -- I understand that. And --
MR. DEAN: Okay. Well --
MS. O'LEARY: -- I asked --
MR. DEAN: -- you're implying --
MS. O'LEARY: -- him if --
MR. DEAN: -- that he --
MS. O'LEARY: -- he agreed.
MR. DEAN: -- said that. You're implying to him --
MS. BAUGHMAN: He did -- he did not agree.
MS. O'LEARY: All right. And I'm asking him, Why?
BY MS. O'LEARY:
Q Why is it that the models don't grossly --
A Well, because --
Q -- approximate real-world --
A -- the -- the --
Q -- physics -- I'm --
A -- models we --
Q -- sorry. Sorry --

A -- are using --

Q -- Professor Aral.

A Okay.

Q -- don't grossly approximate real-world physics, chemistry, and biology?

MR. DEAN: Object to the form.

A I don't agree with that.

BY MS. O'LEARY:

Q Right.

Why? Why don't you agree?

A Because our models are good models.

Q But, I mean, can't a model be good and still be only a gross approximation?

A No, it wouldn't be --

Q Why not?

A -- if it is done -- if it is done well, calibrated well, the model represents the assumptions you have initially introduced into it and predicts what those initial assumptions -- assumptions you have mathematically correctly.

Q Mathematically correctly, though.

But, I mean, we're talking about how it compares to the real world. Right?

The real world isn't in, for example --

A Well, then --

Q -- seven layers.
A -- it --
Q And that's what the model had. Correct?
A Yes. That they plot --
Q And then, the --
A Yeah. Go ahead.
Q The real world's not in 50 by 50 squares. But that's what the model had. Right?
A Right.
Q And the real world has variable biodegradation rates based on changing parameters throughout the distance between a contaminant source and the wells.
And the model didn't have that. Right?
A The model we have worked with is an approximation of the environment we are working in -- with.
And we are satisfied with the representation of that environment within that model, and we are trying to go through the discussion of how far should we go further in time spent in calibrating this model --
Q Uh-huh.
A -- to best fit what we have observed at the field?

So this is not a question of whether the model represents the field conditions correctly or grossly. That's not the question.

The question is what we have assumed in building this model represents the field -- or -- or the -- the -- the environment approximately, but correctly in terms of our understanding at the beginning. Okay?

So when we start there, we cannot argue whether the results are gross or exact.

Q Because you just don't know?

A No.

We know a bound of analysis based on uncertainty, that it should reflect the -- the field conditions within a certain degree of accuracy.

Q But only within the -- the range of parameters you chose to look at for the field --

MR. DEAN: Object to the form.

BY MS. O'LEARY:

Q -- parameters; correct?

A We are modeling. We cannot use all the range of field parameters that is available to us.

Q Okay. You can set aside Exhibit 18. And if you could find Exhibit 4, the Hadnot Point Chapter A?

MR. DEAN: Supplement two?
MS. O'LEARY: No. Chapter A. Exhibit four.
MS. BAUGHMAN: That would be Exhibit four. Yeah.
MR. DEAN: Oh.
THE WITNESS: Uh-huh.
MR. DEAN: Yeah.
BY MS. O'LEARY:
Q And could you go to page A46?
And so there's a figure there, Figure A18. And its label says, Reconstructed Simulated and Measured Concentrations of Trichloroethylene and Selected Water Supply Wells Within the Hadnot Point Industrial Area.
A Uh-huh.
Q So --
A That's figure eight, 18 -- A18.
Q A18. Yes.
A Yeah.
Q Do you agree that this Figure A18 shows the calibrated model values plotted with some measured values at HP well 601, 602, 608, and 634?
A Yeah. That's what the titles say.
Q Do you agree that the Figure A18 shows

some of the measured values at those wells, but not the non-detections?

A Uh-huh.

Q Okay. And so any non-detections are not on these -- on these graphs?

A I have no idea.

You are just referring to four figures, four wells, and then, asking a universal question as --

Q No. I --

A -- to all --

Q -- mean, for --

A -- the wells.

Q -- no. I mean, for these four wells, the non-detections are not --

A I don't --

Q -- shown?

A -- know.

Q Okay.

A I don't remember that.

MS. O'LEARY: Can we get number 43?

And I'm -- I'm going to have you -- I'm going to need you to compare. So if you could keep Exhibit --

THE WITNESS: Okay.

MS. O'LEARY: -- 4 nearby.
This will be Government Exhibit 19.
(Whereupon, Government's Exhibit Aral 19, Chapter C at Hadnot Point, was marked for identification.)
THE WITNESS: Uh-huh.
BY MS. O'LEARY:
Q And can you go to page C95?
A C95?
Q Yup.
Okay. Professor, are you on page C95?
And you should be looking at a Table C7?
A Yes.
Q Okay. So that table says it's a summary of analyses of PCE, TCE, DCE of various kinds and vinyl chloride in samples collected in Hadnot Point water treatment plant water supply wells.
So I'd like you to look at HP634, and look at the TCE column.
A Uh-huh.
Q And there are, looks like, four non-detections.
Do you see those?
A Yes.
Q Okay. So there are four non-detections

of TCE at HP634, for example.

But if we go back to Exhibit 4, which is the Chapter A, at that figure A18 on page A46, for wells 634, there are no non-detections on that chart. Is that correct?

A 634?

Non-detects are not shown in here as a data point.

Q Yeah. Okay. You can set aside Exhibit 19, which was the Chapter C at Hadnot Point.

A Chapter what?

Q You can set aside --

A Okay.

Q -- Exhibit 19.

A Okay.

Q So Chapter -- Exhibit 4 please keep. And you can set aside --

A Okay.

Q -- Exhibit 19.

And can you go in Exhibit 4, Chapter A, to page A51?

A Yes.

Q All right. So there's a figure A20 that says --

A Yeah.

Q -- it's reconstructed, simulated, and measured concentrations of benzene at selected water supply wells at Hadnot Point industrial area, Hadnot Point Holcomb Boulevard study.

And it's showing three wells, HP 602, HP 603, and HP 608.

And were you involved at all -- or are you aware of the data on benzene detections at the Hadnot Point water treatment plant?

A Well, it says "TechFlowMP." So I must be involved.

Q Okay. So -- and are you, then, familiar with the benzene detections at the wells in Hadnot Point?

A These are the data points that we had, apparently, on benzene on these wells.

Q Okay. Do you agree that these figures show calibrated model benzene concentrations at these three wells -- HP 602, 603, and 608, as well as some measured values?

A Yup.

Q Okay. If I look at well HP 603, I don't see any measured values.

Do you know why that is?

A I don't know.

There must be no data on that.

Q Why do you think there must be no data on that?

A Well, we didn't put data points on that figure.

Q Okay. Can you pull back up Exhibit 19, the Chapter C for Hadnot Point?

A Yes.

Q And go to page C98.

A Okay.

Q So if you look at -- now, this -- there's a Table C8.

A Uh-huh.

Q And it says, Summary of Analyses for Benzene, Toluene, Ethylbenzene, and Total Xylene in Water Samples Collected in Hadnot Point Water Supply Wells.

And do you see the entries for HP 603 in the column for benzene?

A Uh-huh.

Q All right. Do you see that there are seven entries for benzene, and they're all non-detections?

A Yes.

Q Okay. So does that mean that in --

A These plots didn't include non-detects.
Q You didn't include the non-detects --
A Correct.
Q -- in well HP 603?
A Yeah.
Q Okay. So I --
MR. DEAN: Objection to form.
They don't show up on log scales anyway.
A Uh-huh.
BY MS. O'LEARY:
Q So if you look at -- back at page A51, that --
A Uh-huh.
Q -- figure A20?
A Uh-huh.
Q For H -- well HP603, what does the red line represent?
A 603?
Q 603. I'm sorry. I might have said something wrong.
603?
A Yeah. Okay.
Q What does the red line represent?
A The simulated benzene concentrations at

this well location.

Q Okay. And does the -- am I correct in understanding this shows the simulated benzene concentrations at -- at well HP603 at some point exceeded a hundred micrograms per liter?

A It shows that.

Q But then when we looked at the table in chapter C --

A Uh-huh.

Q -- there were only nondetections at well HP603?

A That's correct.

Q Okay.

A But again, you are making the mistake of comparing point values at a point in time and a point in space with the overall calibration of a model.

Q Uh-huh.

A You are confused in that.

Q Can we go to page A81?

A A81?

Q Yup. So same -- same exhibit.

A Okay.

MR. DEAN: Oh, A.

MS. O'LEARY: A, yeah.

A A81?

BY MS. O'LEARY:

Q Yeah. And the --

MR. DEAN: A81.

BY MS. O'LEARY:

Q -- column on the left --

A Yeah.

Q -- and as I send [sic] this -- the first sentence starts, "As previously discussed."

But, "Simulated results for water supply well HP602 provide reasonable agreement with field data, whereas simulated results for water supply well HP603 are inconsistent with field data. Therefore, sensitivity analyses were conducted to assess the effect of varying contaminant, source, area, size, location, and release date on reconstructed benzene concentrations at water supply well HP603 and at the HP water treatment plant.

"Additionally, the sensitivity analysis included assessing the effect of the contribution of benzene contaminated groundwater from well HP603 on benzene concentrations in finished water at the Hadnot Point water treatment plant."

Now, were you involved in this sensitivity analysis on HP603?

A Yes, I was.
Q Okay. Am I understanding from what I just read on A81 that the ATSDR recognized the simulated results for water supply well HP603 as inconsistent with field data?
A That's what it says, yeah.
Q Okay. And still on --
A We established that --
Q Uh-huh.
A -- in our prior discussion.
Q And if you go onto the next page, just A82, there's a description of a -- of the sensitivity analysis that was done.
And am I correct in understanding that in the sensitivity analysis, they determined that varying the source concentrations caused only small improvement at --
A A- --
Q -- while 603 --
A -- -83 is only figures and you are --
Q A --
A -- referring to --
(Whereupon, the court reporter requests clarification)
A A -- A83 is only page for figures. You

are actually referring to A -- A82.
BY MS. O'LEARY:
Q A 82.
A Okay.
Q Yeah.
A Okay.
Q At the top.
A Uh-huh.
Q I can read what it says.
It says, "Sensitivity analysis results for varying assigned source concentration value from a calibrated value of 17,000 micrograms per liter, and source release date from the calibrated release date of January 1st, 1964, are listed in table A25. These results indicate a small improvement in reconstructed benzene concentrations while HP603 compared to calibrated results."
So am I correctly understanding that the sensitivity analysis found only small improvement in HP603 by varying source concentrations?
A The sensitivity analysis looks at the effect of the variations of a certain parameter on the results. So in this case, actually, we are changing the source concentrations to see if it has an effect on the 603 -- well 603.

And we are concluding that the change in source concentrations does not effect that much.

Q Okay. And -- and going on after that, it says, "Perhaps more important however, in the context of the overall project, is that the effect of these contaminant source variations on finished water benzene concentrations at the HP water treatment plant is minimal."

Do you agree it's more important in the context of the overall water modeling project at Hadnot Point that the contaminant source variations of the sensitivity analys- -- analysis on finished water on benzene concentrations at the Hadnot Point water treatment plant is minimal?

MR. DEAN: Object to the form of the question.

A Yeah.

BY MS. O'LEARY:

Q Okay.

A I think it says that, yes.

Q And to -- and then its goes on to say, "To assess the contribution of reconstructed benzene contaminated groundwater from water supply well HP603 to finished water concentrations at the Hadnot Point water treatment plant, the mixing model

results were derived by removing the flow and contaminant mass contribution from well HP603.

And then it says "The reconstructed benzene concentration results shown in figure A36 indicate that the contribution from benzene contaminated water supply well HP603 to finished water concentrations at the HP water treatment plant was minimal."

And then --

A Yeah.

Q Do you agree?

A What -- yeah.

What we are saying is if we change the source date it has also minimal effect.

Q Okay. And if -- if HP603 does not have a big effect on the water treatment plant calibration, then does that mean that the calibrated model is drawing most of the benzene from different wells?

A Not the calibrated model. The water treatment plant is receiving contaminants from different wells, yeah.

Q Right.

A Yeah.

Q So if -- if -- so the specific well, HP603, has a changing source loading on that well

has a minimal effect on the water treatment plant levels, then does that mean in the model the source of the benzene is primarily other wells, not 603?

A No, that -- that's not what it says.

It says changes in the source value doesn't effect the water treatment plant concentrations. It doesn't say that the source at this well doesn't effect.

Q Well, isn't that what they varied, was the strength of the source at 603?

A No. There is a source. Let's --

Q Sure.

A -- say a hundred milligrams per liter, that's going to water treatment plant.

Now, if you make it 110 or 90, it doesn't make any change on the water treatment plant. But there is still hundred milligrams of contaminant in that --

Q Uh-huh.

A -- well.

Okay? I mean, the changing effects is not important but the source is still there, whatever it is.

Q Isn't the uncertainty analysis to see what happens when you vary the source strength?

A Yeah. But you are asking me if you take the 603 out --

Q Yeah.

A -- it's not going to change the water too. That's not true.

What I'm trying to tell you is there's a source which contributes to water treatment plant concentrations. A hundred milligrams, maybe ten milligrams of it goes to water treatment plant.

Q Uh-huh.

A Now, if you make the source or change the source value to 120 or 80, still ten goes to the water treatment plant.

Conclusion is not if you take 603 out, still there's no change in the water treatment plant. No.

Ten milligrams you are taking out now from the water treatment plant by taking out 603 totally.

Q Okay. You can set aside chapter A and we are going to go back to supplement six, which was Exhibit 11.

A Exhibit 11.

Q And to page S645.

Actually, to -- yeah. S645, that's

correct.

A Okay.

Q Okay. So in the column on the right, the second paragraph begins, "For contaminant fate and transport modeling reported herein. However insufficient -- however insufficient water quality data existed to conduct a statistical analysis for assessment of model calibration fit. In addition, specific data pertinent to the timing of initial deposition of the contaminants in the ground or subsurface chronologies of waste disposal operations, such as dates and times when contaminants were deposited in the HPLF or descriptions of the temporal variation in contaminant concentrations in the subsurface generally are not available.

It goes on, "Determining these types of source identification and characterization data became part of the historical reconstruction process whereby the contaminant fate and transport model was used to test source locations, varying concentrations, and beginning and ending dates for leakage and migration of source contaminants to the subsurface and underlying groundwater flow system."

Were you involved in that process of

determining the types of source identification and characterization data?

A No. I'm not an author on this report so I wouldn't know what is the procedure -- what are the procedures they have used and I don't remember --

Q Okay.

A -- this paragraph.

Q Okay. And were you involved in the process of testing source locations by varying concentrations and beginning and ending dates?

A That -- this is -- let's see. In the landfill area.

We referred to that earlier in one of the other exhibits that we tested the start and ending dates of the wells. It didn't have any effect. We tested the source concentration magnitudes, it didn't effect.

So is this the same well or is this a different site? I -- I have no idea what we are talking about.

Q I mean, this chapter is about all of the wells.

A The previous --

Q At Hadnot Point.

A -- chapter was on benzene application only? Is that what we discussed a minute ago?

Q So we were talking about chapter A, which is the summary of findings and chapter C, which is about occurrence of all --

A No -- no.

Q -- contaminants.

A We were looking at some figures that nondetects were used or not used and we were talking about sensitivity analysis we used, just to see if the source concentration changed or if the time of application of the contaminant at the site changes. It didn't change anything.

So you ask me the question, if you take this well off will there be any change in the water treatment plant?

I answered the question as, "yes."

Now we are coming to this supplement --

Q To supplement six.

A -- six.

Is this -- I -- I'm not familiar with this chapter. I haven't authored it.

Are these paragraphs referring to what we have discussed a minute ago, which I have summarized?

Do you know that or --

Q I don't know.

A I don't know it either.

Q Okay.

A So --

Q Are you offering opinions about the calibration assessment of Hadnot Point?

A I'm offering opinions on a paragraph that you wrote or read -- read on this chapter.

Q So supplement six is called, "Characterization and simulation of fate and transport of selected volatile organic compounds in the vicinities of the Hadnot Point industrial area and landfill."

Were you involved in any of those processes?

A No. I'm not an author on this report so I have no idea what's in this report.

Q Okay. So are you offering no opinions on anything contained in supplement six?

MR. DEAN: Object to the form.

A If I'm not an author the only thing I did, probably, I reviewed it.

BY MS. O'LEARY:

Q Okay. Are you offering any opinions

about mass loading at Hadnot Point?
A At certain sites I'm looking at benzene mass loadings that I have described a minute ago that it did effect it didn't effect and so forth. So I have an opinion on that but I don't have an opinion on this supplement six.
Q On benzene, let's start there. Were you involved in -- are you offering opinions, I mean, on the appropriateness of the calibrated value --
A Yeah.
Q -- for mass loading?
A Yeah. That study -- benzene study was done with TechFlowMP.
Q Okay. Are you offering opinions about the quality of the calibrated values of mass loading of the other contaminants at Hadnot Point?
A If my -- if -- if that is a study which I have done and I was involved in writing the report, yes, I'm going to offer an opinion on it. But the reference, the Exhibit 11 is written by some other group at ATSDR.
I'm not the author so I'm not going to offer an opinion on that.
Q If we stay on supplement six and page S645, where we were, still in the column on the

right --

A Six. Just a moment.

Exhibit six or --

Q No. It's Exhibit 11.

A Yes.

Q What we were on.

A And you are going back to the --

Q -- to S6.

A -- supplement that I'm not an author, I'm not an involved participant. Maybe I have just reviewed it and you are going to ask me a question --

Q Yes --

A -- about it again.

Q -- I have questions about it --

A Okay.

Q -- about S640.45.

So it said --

A 645?

Q Yeah. The column on the right --

A Yeah.

Q -- the third paragraph says, "Conducting a robust uncertainty analysis using Monte Carlo analysis requires simulating thousands of realizations. When using available computational

equipment, the HPIA and HPLF models have a simulation time of about six to eight hours for each simulation. The lengthy simulation times and the substantial data limitations therefore make a comprehensive uncertainty analysis computationally prohibitive based on available resources and time limitations. Thus the ranges values presented in the sensitivity analysis section of this report assess a limited number of input and output model parameter.

"The results, i.e. range of concentration presented in the sensitivity analysis reported herein should not be considered or interpreted as the results of a robust and comprehensive uncertainty analysis but do provide insight into parameters, sensitivity, and uncertainty in a qualitative sense."

Were you involved at all in an uncertainty analysis at Hadnot Point using Monte Carlo analysis?

A Yes. Not on this supplement though, on other applications, in other locations, in Tarawa Terrace, in benzene analysis. Yes.

Q But in Hadnot Point were you involved in an uncertainty analysis using Monte Carlo analysis?

A In other sites, yes.
Q What sites?
A What sites?
Q Yeah.
A Fuel farm, under storage tanks, benzene leakage, modeling of benzene using TechFlowMP. If I did the modeling I did the uncertainty analysis.
And I don't know what this is doing or what is this all about that we are looking at right now. I don't know that.
Q Can you go back one page --
A Uh-huh.
Q -- to S6.44?
A Yeah.
Q And there's a figure S6.23.
A Yes.
Q It says, "It's variations and reconstructed are simulated finished water concentrations of trichloroethylene derived using Latin hypercube sampling methodology on water supply well monthly operational schedules Hadnot Point water treatment plant, Hadnot Point-Holcomb Boulevard study area."
Do you see that?
A Yes, I see that.

Q And were you involved in the --
A I wasn't --
Q -- in this process?
A I wasn't involved in anything that you are showing me in this report, supplement six.
Q So -- so Professor Aral, you've told me that you weren't involved in supplement six but you were involved in Monte Carlo simulations at other areas of Hadnot Point.
This is where Monte Carlo simulations of from Hadnot Point are --
A I'm not the only --
Q -- report -- are reported --
A I'm not the only person who can do Monte Carlo analysis. Other teams within ATSDR can do that too.
Q Right. But --
A So at different sites we took the tasks onto us to do the simulations and then do the uncertainty analysis.
In this task, whatever this is, this is done by some other group. Anybody can do uncertainty analysis.
Q Sure.
A Yeah.

Q I don't disagree with you.
But the ones reported by the ATSDR are here in chapter A, supplement six. So where are the Monte Carlo simulations that you did on Hadnot Point? Where are they -- they reported?
A I have not done supplement six uncertainty analysis. Wherever this site is, whoever was responsible doing this simulation who did the analysis is not my group.
Q No, I understand that.
So where are the -- the simulations you did reported?
A Well, we -- we had done the benzene analysis --
Q Sure.
A -- there's a chapter on that. We did the simulations on underground storage tanks, there's a chapter on that. If we made the simulation, we are responsible of the sense -- uncertainty analysis associated with that.
If you -- if you want to go back to those chapters, I can answer all your questions.
Q Were you involved in the sensitivity or uncertainty analysis other than the benzene and the underground storage tanks?

A If -- I don't remember all the tasks that I was involved with. But if you find a report which does a simulation analysis at the different site and my name is not on the report, I have not done that study.

Q Okay. So you can set aside exhibit 11.

A Okay.

Q And I have a few questions about your -- the timeline of your involvement in the ATSDR water models and their reviews by various entities.

A Yeah.

Q So we've already talked about how you started working with ATSDR with a cooperative agreement with MESL --

A Right.

Q -- around 2000.

A Right.

Q And then you've already mentioned that there was the expert panel in 2005 that the ATSDR --

A That's correct.

Q -- convened.

Is that right?

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:
Q "Convened."
And at that ATSDR panel, did you know any of the panel members before it was convened?
A Can you read the names?
Q Yeah.
Barry Johnson (phonetic), Robert Clark (phonetic), David Dougherty (phonetic), Benjamin Harding (phonetic), Leonard Konikow, Eric Laball (phonetic), Peter Pomerank (phonetic), Vijay Singh (phonetic), James Uber (phonetic), and Thomas Walski.
A I know Vijay Singh. I know James Uber and I read papers from Konikow. Probably I read papers from other names that you just read --
Q Okay.
A -- but I don't know them, personally.
MS. O'LEARY: And can we grab 54, if we haven't already?
(Whereupon, Government's Exhibit Aral 20, Expert Peer Review Panel Evaluating ATSDR's Water Modeling Activities In Support of the Current Study of Childhood Birth Defects and Cancer At U.S. Marine Corps Base Camp

Lejeune, North Carolina, was marked
for identification.)
BY MS. O'LEARY:
Q Professor Aral, here's --
A Uh-huh.
Q -- Exhibit 20.
A Yeah.
Q And this is -- says it's the "Expert peer review panel evaluating ATSDR's water modeling activities in support of the current study of childhood birth defects and cancer at U.S. Marine Corps Base Camp Lejeune, North Carolina."
And have you -- have you seen this development before?
A Most probably, yes.
Q Is this the report that came out after the expert review panel in 2005?
A I presume, yes.
Q Okay. I'd like to turn your attention first to page 20 -- well, I guess it's page 29.
A Seventy-nine?
Q Twenty-nine.
A Twenty-nine.
Q In section --
A Yes.

Q -- section --
A Summary of recommendations.
Q Yeah. In section 6.4.
A Okay.
Q And they -- so 6.4 says, "Data analysis, Hadnot Point area."
Oh, sorry. Can we go back to 20 -- page 29, 6.2 chronology of events?
A Okay.
Q Okay. So in that section it's: "The panel members recommended that ATSDR focus its next efforts on refining its understanding of chronological events. These need to include documenting periods of known contamination times when water distribution systems were interconnected and the start of operations at the Holcomb Boulevard water treatment plant."
So my understanding, this was a recommendation of the expert panel.
A Yes.
Q And did the ATSDR follow up on this recommendation to refine its understanding of chronological events?
A I think the answer is yes. And I think we also developed a specific application to look

into the interconnectedness of the two water treatment plants or --

Q Uh-huh.

A -- systems. We used the Markov chain analysis at that time.

MS. O'LEARY: And you can set this one aside.

Have we used one yet?

(Whereupon, the court reporter requests clarification.)

MS. O'LEARY: It was just a question, do we have one --

Exhibit 13. Would you grab Exhibit 13?

(Whereupon, there was a discussion off the record.)

THE WITNESS: Exhibit 13?

MS. O'LEARY: I guess it's just a few pages.

BY MS. O'LEARY:

Q Is that it?

A Uh-huh.

Q Yeah. There you go.

A Uh-huh.

Q And this is the -- we looked at it

before -- but this is the transcript of that expert panel.

A Okay.

Q And can we go to page 20 of the transcript? So not of the document.

MS. BAUGHMAN: We only have --

MS. O'LEARY: Not of the document, of the transcript.

So it should say "20" in the top right corner.

THE WITNESS: Twenty?

I don't see a page 20.

MS. BAUGHMAN: We don't have 20.

MR. DEAN: We don't have 20.

MS. O'LEARY: Oh, you don't have a page 20?

MS. BAUGHMAN: No.

MS. O'LEARY: All right. Then never mind. We'll skip that one then.

MS. BAUGHMAN: You want to see? It's the --

MS. HORAN: No, I believe you.

MS. O'LEARY: No, we believe you.

MS. BAUGHMAN: Okay.

MS. O'LEARY: Can we just --

MR. DEAN: Let me see that?
MS. HORAN: We believe you.
MR. DEAN: Oh, I was just giving back to --
MS. HORAN: I'll look but we believe you.
MR. DEAN: I was just giving it back to you in case you wanted to reuse this.
MS. HORAN: What?
MS. O'LEARY: Can we go back then to 54, which is the one that we had before. It's got this tan cover.
THE WITNESS: Okay.
MS. BAUGHMAN: Is that 13?
MS. HORAN: Yeah.
MR. DEAN: Okay.
MS. HORAN: He'll need it back.
MS. BAUGHMAN: What are we on now? What --
MS. O'LEARY: Well, we are pulling up this one, which is --
MS. HORAN: Exhibit 54 -- Exhibit 20?
MS. O'LEARY: -- twenty.
THE WITNESS: Exhibit 20?

MS. BAUGHMAN: We are going back to Exhibit 20?

MS. HORAN: Yes.

MS. BAUGHMAN: All right. The last one?

MS. HORAN: Yes.

MS. BAUGHMAN: What page?

MS. O'LEARY: We'll be heading for page --

THE WITNESS: Oh, my God.

MS. O'LEARY: -- 121.

THE WITNESS: Wait a minute.

MS. O'LEARY: Oh, there it is.

THE WITNESS: Yeah.

MS. O'LEARY: That's it.

THE WITNESS: 121?

MS. O'LEARY: Page 121.

MS. BAUGHMAN: Is this Exhibit 20?

MS. HORAN: It should be.

THE WITNESS: Page 121?

MS. BAUGHMAN: Yeah, but there's no page 121.

THE WITNESS: There's no such --

MS. BAUGHMAN: There's no --

MS. O'LEARY: Oh, it's section -- I

think that's the document number.

So it's section two point -- or 4.2.4, which will be --

THE WITNESS: Four point two point four.

MS. O'LEARY: There we go.

So that will be page 21.

THE WITNESS: Page 21. Okay.

Okay.

BY MS. O'LEARY:

Q And this -- so there's a section 4.2.4, suggested modeling approaches, modifications and considerations.

And in the section on groundwater, kind of in the middle there's a paragraph that begins "Dr. Walski."

Do you see that?

A Yup.

Q Can you read that paragraph?

A "Dr. Walski suggested performing an overall classification of the areas where contamination was known to occur and the areas without contamination. People in the contaminated areas will be considered exposed and those in the uncontaminated areas will be classified as

unexposed.

"He's also recommending -- he also recommended that ATSDR use modeling to concen- -- concentrate on the areas where contamination and exposure are known. As a next step, he recommended ATSDR prepare a matrix to determine a timeframe when contamination did or did not occur."

Q Okay. So at -- at the time of this expert panel in 2005, was ATSDR working primarily on Tarawa Terrace?

A Yeah.

Q And ATSDR did not ultimately decide on simpler classification systems like Dr. Walski described; is that correct?

MR. DEAN: Objection to the form.

A I think this recommendation on simple models were associated with the next phase which is Hadnot Point and Holcomb Boulevard -- Boulevard areas.

BY MS. O'LEARY:

Q Okay.

A Yeah.

Q Well, if we go down, the next line that says "Dr. Walski," so it's the last one on page 21 --

A Yeah.
Q -- Exhibit 20.
It says "Dr. Walski considered the historical pattern of contamination at Hadnot Point too complex to model because the numerous sources cannot be correlated to particular wells."
A Yeah.
Q So why was that advice not taken by the ATSDR?
A It was. It was considered.
Q Well, but they did -- they did model Hadnot Point, didn't they?
A Yeah, they did. But they didn't model the whole Hadnot Point area as we did the Tarawa Terrace area. We did --
Q What do you mean --
A We did individual sections of it where there's a contamination of benzene. We looked at the sources. We just modeled that source propagation as the main parameter.
We looked at the landfill application separately.
Q Uh-huh.
A We used simpler models in there as well. So we -- we followed all these recommendations.

Q Does that mean in the Hadnot Point-Holcomb Boulevard area water model, the groundwater contaminant fate and transport don't cover the whole area, it's just --
A No. No.
Q -- localized?
A It covers -- the groundwater flow area is done for the -- done for the whole section of Hadnot Point Holcomb, Boulevard, etc., etc.
But when you introduce the contaminant transport over that, overlay it, you just look at the benzene concentrations where the source is, like underground storage wells or spillage that occurred in certain years, so you don't look at the benzene plus the landfill area TCE concentrations at the same time.
So different applications at different sections of the model region was considered.
Q Okay. And then I have questions for you about the natural resource --
A Uh-huh.
Q -- the NRC, the National --
A Right.
Q -- Academy of Sciences --
A Right.

Q -- National Resource Council --
A Right.
Q -- because they under -- they published a report on the Camp Lejeune water studies; correct?
A That's correct.
Q And you talked about those in your expert report --
A Yes.
Q -- in this case; right?
A Yes, that's correct.
MS. O'LEARY: Let me grab that report. It's five.
(Whereupon, Government's Exhibit Aral 21, Report, was marked for identification.)
BY MS. O'LEARY:
Q Here is Government Exhibit 21, Professor Aral.
(Whereupon, there was a discussion off the record.)
BY MS. O'LEARY:
Q And Professor Aral, I'd like to go to what should be called page one.
This one starts with some Roman numerals before the main numbers.

A Page one?
Q Yup. Which is not -- not close to the first page.
A Oh.
Q It's in a little ways.
When you get there, it should say "Public summary and context" at the top.
A Yeah.
MS. BAUGHMAN: What page are we on?
MS. O'LEARY: It's page one, but that's quite a ways in.
It says, "Public summary and context" at the top.
THE WITNESS: Uh-huh.
MS. BOLTON: What's the ending Bates number?
MS. O'LEARY: Oh, yes. The ending Bates number is -452.
BY MR. DEAN:
Q So those little numbers on the bottom right.
A Yeah.
Q Okay. So in this page, it says the "Charge to the committee" --
A Uh-huh.

Q It says, "The National Research Council conducted this review in response to a request from the U.S. Navy, the department under which the Marine Corps operates. The Navy was mandated by the U.S. Congress to request a review by the NRC to address the evidence on whether adverse health outcomes are associated with past contamination of the water supply at Camp Lejeune.
"The NRC developed specific instructions for the scope of the review. It then rerecruited and appointed a committee of scientists with diverse but pertinent backgrounds and perspectives to carry out the review."
Do you have any reason to think that's inaccurate?
MR. DEAN: Object to the form of the question.
A Can you repeat that?
BY MS. O'LEARY:
Q Yeah.
Do you have any reason to think that's inaccurate, that opening paragraph?
MR. DEAN: Object to the form --
A I think it's inaccurate.

BY MS. O'LEARY:
Q You think it's what?
A Inaccurate.
Q How is it inaccurate?
A It's inaccurate because they were asked to address the evidence on whether adverse health outcomes are associated with past contamination in water supply at Camp Lejeune. They only -- what they only did, they didn't do a study to address that, they only criticized the ATSDR work.
Q Do you agree that the Navy was mandated to request the review by the NRC?
A It says that. To request a review by the NRC to address the evidence on whether adverse health outcomes are associated with past contamination of the water supply at Camp Lejeune.
So they are asking NRC to do what ATSDR did in that request.
Q Right. And that was what was mandated by Congress.
A Yeah. But they didn't do that.
Q Okay.
A They only criticized the ATSDR water modeling work.
Q You don't think a critique is a -- is a

review?

A It's -- they are not asking for a -- oh, request a review to me implies that they reviewed the whole analysis, themselves.

Q Okay. If you -- I want to turn, actually, to your report, which is --

MS. HORAN: Two.

BY MS. O'LEARY:

Q -- two, Exhibit 2.

A Exhibit 2?

Q Yes.

A Exhibit 2, Exhibit 2, Exhibit 2 -- Exhibit 8, Exhibit 7, 11, 17...

Q And I want to go to page 12, which we looked at --

A So let me first find this.

Q Oh, sorry.

A The --

Q Is that it there on the right, on that stack? Oh, no. It's not -- that's not the marked one.

Here it is, Professor Aral --

A Okay.

Q -- it's right here.

A Yup.

Q So to page 12.

Okay. So this is that bullet-pointed list that we've seen before.

And the last bullet point, where you say, "The model results show finished water at" -- excuse me.

Not the last bullet point, the second to last bullet point.

It says, "The models and techniques used by ATSDR for historical con- -- reconstruction including fundamental equations, input parameters, parameter estimates, calibration uncertainty, and sensitivity analyses were and remain reliable, scientifically valid, and state of the art procedures that are consistent with standard practices used and are generally accepted in this field."

What does it mean for the simulated -- or -- no.

What does it mean for these to be mathematically reliable, statistically accurate, and correct?

A That means the models that we are using or used, like the ones that we have developed at Georgia Tech, are mathematically correct. Meaning

the procedures that we define in mathematical terms are correctly transported into a mathematical model application without an error.

Statistically correct means the application results provide estimates of uncertainty analysis as well and the deterministic results that we are predicting is within the bounds of that uncertainty analysis.

Q Okay.

MS. O'LEARY: And I just need a few minutes break. Can we take a break right here?

THE WITNESS: Okay.

MS. O'LEARY: I need about ten minutes.

THE VIDEOGRAPHER: The time right now is 4:30 p.m. We are off the record.

(Whereupon, there was a recess taken from 4:30 p.m. to 4:41 p.m.)

THE VIDEOGRAPHER: The time right now is 4:41 p.m. We are back on the record.

THE WITNESS: Okay.

BY MS. O'LEARY:

Q Thank you, Professor Aral. So if you can

stay looking at your report, which was Exhibit 2 --
A Yes.
Q -- Government Exhibit 2, and go to page 13 --
A Yes.
Q -- where that bulleted list continues?
A Uh-huh.
Q So the first item on that -- on page 13 says, "The simulated monthly mean concentrations of TCE, PCE, 1,2-TDCE, benzene, and vinyl chloride at Tarawa Terrace, Hadnot Point, and Holcomb Boulevard included tabulated or in figures in ATSDR reports are reliable and represent, within a reasonable degree of scientific and engineering certainty, the contaminant levels in finished water at Camp Lejeune from 1953 to 1987."
MR. DEAN: Okay.
BY MS. O'LEARY:
Q What is that reasonable degree of scientific and engineering certainty for the monthly mean concentrations?
A That's -- that would be probably best described with the deterministic results being in between the uncertainty bounds of the application.
Q How does that relate to their reliability

to what the actual historical values were?
A Reliability --
MR. DEAN: Object to form.
A What -- what do you mean by reliability?
BY MS. O'LEARY:
Q So the simulated monthly mean concentrations for TCE, PCE, DCE, benzene --
A Uh-huh.
Q -- and vinyl chloride at Tarawa Terrace, Hadnot Point, and Holcomb Boulevard what is -- do you have an opinion on how close those values are to the historical values they are trying to estimate?
A Yeah.
MR. DEAN: Object. Object to form.
A Uh-huh. I looked at the final results on -- on uncertainty analysis and the mean values. I -- we can notice that at the initial phases of the simulation, the mean values are probably at the high side of the uncertainty band but between -- I don't remember exactly, but 1960s onward to 1980s -- '85, I think the mean values are right at the -- in the middle part of that uncertainty -- uncertainty band --
BY MS. O'LEARY:
Q Are the --

A -- so --

Q Are the simulated monthly mean concentrations within 10 percent of the unmeasured historical values?

MR. DEAN: Object to the form.

A Ten percent of historical values --

BY MS. O'LEARY:

Q Yeah.

A -- of what?

Q Of the contaminant concentrations.

That what the true monthly mean contaminant concentrations were --

A In the --

Q -- are the simulated values within ten percent of those?

A In a --

MR. DEAN: Object to the form.

A In a statistical sense, if you look at it from a statistical distribution, the results are within less than ten percent of the --

BY MS. O'LEARY:

Q Within what statistical sense?

MS. BAUGHMAN: He's not finished.

BY MS. O'LEARY:

Q I'm sorry. Go ahead.

A I'm -- I'm looking at the results that we are presenting within the uncertainty band and the mean deterministic results are lying just at the center of that uncertainty band.
If you are asking how does the predictions go with the observed water treatment plant concentrations, there's a significant variation on that but statistically they are on target.
Q I'm not asking about either of those. I'm asking about for the unmeasured historical mean concentrations --
MR. DEAN: Object to form.
BY MS. O'LEARY:
Q -- how close to those can you say that the simulated monthly mean values are?
A Okay. What you are asking is, what is the accuracy or model prediction results in reference to historical contamination at the site --
Q That's right.
A -- during which we didn't have any data but we needed the data for the epi study, right?
Q That's right.
A Okay.
There's no other way in mathematical

model done for the Camp Lejeune site which wrongly predicts that range but rightly predicts the water treatment plant. That cannot be developed.

Q I don't understand what you mean.

A That means the accuracy of the model within the range of the timeline where we don't have data --

Q Uh-huh.

A -- must be accurate so that we are getting to the right water distribution plant concentrations.

Q But don't -- don't you --

A That's -- that's, in a sense, what we call validation issue.

Q But aren't there multiple solutions to what the historical concentrations could have been --

A That's exact --

Q -- that arrive at the same concentrations --

A That --

Q -- that we actually know about in the 80s?

A That's exactly what I'm saying.

In the overall sense, you cannot develop

a model which totally shows a different trajectory starting from 1953, all the way to '85, totally different trajectory which matches with the water treatment plant concentrations at the level that we have matched.

There's continuity in groundwater flow. There's continuity in contaminant transport plume migration. If you are able to predict the future or present day concentrations --

Q Uh-huh.

A -- in 1987, all the other predictions dating back to 1953 must be correct or --

Q How correct?

MR. DEAN: Object to the form.

A How correct?

Statistically, that's the most rated in the uncertainty ranges associated with the variations that may be included into the model predictions which probably are referring to. And all of that is within the uncertainty bound.

BY MS. O'LEARY:

Q But you said you were not involved in chapter I, which had the analysis of much of the uncertainty in Hadnot Point.

A I'm only referring to the -- not much of

the -- I'm only referring to the work that we have done at Tarawa Terrace, the benzene concentration, landfill application, and the industrial -- not the industrial -- underground storage tanks, which we did.

Similar procedures, similar mathematical techniques are used by other groups within ATSDR, so they followed the correct procedures. And what I say to my work applies to them as well.

Q So you think that the solution that is the calibrated model for Tarawa Terrace is the uniquely best one?

A It is unique in the sense that you cannot produce a totally different trajectory of contaminant movement in the aquifers of Camp Lejeune Tarawa Terrace --

Q Uh-huh.

A -- which ends up consistently with the results that we have predicted.

Q What does totally different mean though? You said totally different.

A Totally mean -- for example, you would like to see the results being less than MCL levels in the Tarawa Terrace area throughout the region of the timeline of the study like an exponential curve

going up and reaching, finally, the water treatment plant concentrations. That's totally different, right?

Q So are you -- you are referring to the overall shape --

A Yup.

Q -- of the curve?

A Overall shape.

Q That the overall shape can't be totally different?

A Cannot be totally different.

Q Okay. But it could be different just not totally --

A It --

Q -- different?

A -- it will be different within the uncertainty bounds of the set statistical limits and the --

Q But that uncertainty bounds you've -- you've acknowledged isn't the whole universe of what could have happened at --

A We are --

Q -- the site.

A -- modeling here. We are not doing the universe application. We are just doing a model of

the universe that you are having to describe in your mind.

Q Right. So I -- my question is how to relate the model to the reality it's trying to emulate. So in that frame --

A All models are approximations to the environment.

Q Uh-huh.

A If you all agree with the assumptions we made in building this model for Camp Lejeune, we have to agree with the results of the model because there are no mathematical errors in there, there are no statistical errors in that analysis. And if the model assumptions are correct, if they are properly describing the environment approximately --

Q Uh-huh.

A -- then the results are correct.

Q But what if they don't appropriately --

MR. DEAN: Object --

BY MS. O'LEARY:

Q -- describe the environment of the model?

A Then you have --

MR. DEAN: Object to the form.

A -- the wrong model --

BY MS. O'LEARY:

Q Then you have the wrong model?

A -- in your hand.

Yeah, if you -- if you can prove that to us, we will accept the mistake.

Q Okay. Moving on from specific modeling questions, just to confirm: Did you do any water modeling at the rifle range, Camp Geiger, Marine Corps Air Station New River, Montfort Point which is also called Camp Johnson, Courthouse Bay, or Onslow Beach water distribution systems at Camp Lejeune?

A No.

Q Okay. And your report does not contain opinions about contamination in water coming from those water systems treatment plants; is that correct?

A That's correct.

Q And do you have an understanding of why no water modeling was done at rifle range, Camp Geiger, Marine Corps Air Station, New River, Montfort Point, Camp Johnson, Courthouse Bay, or Onslow Beach?

A I was not involved in that decision.

Q Okay. And I have another question about your report. It's on page 12. So near where we

were, just one page back, page 12.

A Page 12?

Q Yes.

A Uh-huh.

Q Right in -- near the top, in the 4.1 water modeling section.

A Right.

Q The second sentence says, "The use of modeling for historical reconstruction is an accepted methodology to predict past exposure or contamination levels as demonstrated both in the scientific literature." And then there are some citations. "And in site-specific studies, such as Jacksonville, Florida Naval Air Station, Tucson International Airport/Hughes Aircraft Facility, Oakridge National Lab, Hanford Site, and Toms River Dover Township."

A Yes.

Q I want to explore what you mean by a historical reconstruction being an accepted methodology within -- to predict past exposure to contamination levels and how it compares to what was done at Camp Lejeune.

MS. O'LEARY: So can we look at 52, please?

This will end up being Government Exhibit 22.

(Whereupon, Government's Exhibit Aral 22, Independent Reviewer Comments Document, was marked for identification.)

MS. O'LEARY: Here you go.

THE WITNESS: Uh-huh.

BY MS. O'LEARY:

Q Twenty-two is a document, it goes onto two pages. And the label is, "Independent reviewer comments."

And this isn't on here but I'll represent to you that the time name of this document within materials from the ATSDR was, "Aral_resp_document_2011-05-05_BallockM.docs" (phonetic).

A Wait. Wait. I -- this is the first time I'm seeing this, I think.

What is this?

Q Well, that was my question for you.

The file name had your name in it. It said it was, "Aral resp document," and then the date and then "Bollock M."

A Is -- is that name on this paper?

Q No, it was in the file name --
A Oh, the file name.
Q -- that this document came from.
And so I wondered, do you know who "Mansour Ballock ORISE fellow hydrologist" is? That's near the top in the name and title of reviewer.
A "Monsour Ballock," I don't know this name.
Q Okay.
A No. I --
Q Have you ever seen this document --
A No.
Q -- before?
A No.
Q Okay. You can --
A No.
Q -- set it aside.
MS. O'LEARY: Then can we get 36.
(Whereupon, Government's Exhibit Aral 23, Historical Reconstruction of the Water Distribution System Serving the Dover Township Area, New Jersey, January 1962 to December 1996, was marked for identification.)

BY MS. O'LEARY:

Q Professor, it looks like this will end up as Government 23.

There you go.

So this document is -- title is "Historical Reconstruction of the Water Distribution System Serving the Dover Township Area, New Jersey" --

A Uh-huh.

Q -- "January 1962 to December 1996."

A Uh-huh.

Q And are you familiar with the document that's in Exhibit --

A Yes.

Q -- 23?

A Yes.

Q What is it?

A Yes.

It has my lab's logo on it.

Q Okay. And as I look at the -- I guess it's the third page, but it doesn't have a number --

A Okay.

Q -- but it -- it appears you are listed as an author.

A Uh-huh.

Q Is that correct?
Did you -- are you one of the authors of this document?
A Yeah.
Q Okay. And can you go to the page that has the little Roman numeral four? So little iv?
A Uh-huh.
Q So in the fist paragraph in the column on the left, it -- it starts, in the last sentence, says, "In 1997, ATSDR and NJDHSS determined that an epidemiologic study was warranted and that the study would include assessments of the potential for exposure to specific drinking water sources. To assist the epidemiologic efforts, ATSDR developed a work plan to reconstruct historical characteristics of the water distribution system serving the Dover township area by using water distribution system modeling techniques.
"The numerical model chosen for this effort, EPA net two, is available in the public domain and is described in the scientific literature. To test the reliability of model simulations, water distribution system data specific to the Dover township area were needed to compare with model results. Lacking such data, a field data

collection effort was initiated to obtain pressure measurements, storage tank water levels, and system operation schedules during winter demand and peak demand operating conditions.

"Using these data, the water distribution system was -- model was calibrated to present day conditions. ATSDR released a report and a technical paper in June 2000 describing the field data collection activities and model calibration results."

Okay. So in looking in this, which is one -- this is one of the studies you cited in your report about --

A Yeah.

Q -- the established use of --

A Yeah.

Q -- of forecasting backwards --

A Yeah.

Q -- in -- in use of water models; is that correct?

A Yeah.

Q Am I understanding that in this study at Dover township area, the model involved was just the water distribution system?

Is that correct?

A That -- that's correct.
Q So there was no groundwater model in this --
A No.
Q -- is that correct?
A No.
Q And there --
A We were just using data from pumping wells.
Q Okay. And was there any contaminant fate and transport modeling?
A Yes.
Q What was the contaminant fate and --
A EPA --
Q -- transport --
A -- net --
Q -- model?
A -- two. Contaminant fate and transport in the pipelines, not in the groundwater.
Q Okay. So was there a contaminant fate and transport model in the groundwater?
A There wasn't any groundwater --
Q There --
A -- contaminant transport. But there was contaminant transport analysis in the pipelines.

Q Okay. So within the distribution system?
A Yes.
Q Okay. And then the next paragraph, still on iv, it says, "Having established the reliability of the model and the modeling approach, the model was used to examine or reconstruct plausible historical characteristics of the water distribution system. For this purpose, monthly simulations were conducted between January 1962 through December 1996 to estimate the proportionate contribution of water from points of entry well or well fields to various locations throughout the Dover township area."
A Yes.
Q So do you agree that the results from the Dover township model were a proportionate contribution and not a contaminant concentration?
A Oh, as you know, the contaminant loss within a pipeline system is always negligible. So if you put a concentration of one -- at a certain point -- milligrams per liter, it doesn't matter whether you put 200 milligrams per liter, it's proportionate. The results can be always extended to another concentration level.
Q But what was reported in the Dover township study --

A Is a character --
Q -- was the proportionate contribution --
A Yeah.
Q -- right?
A Exactly.
Q Okay. So the proportionate contribution of a particular well?
A Yeah. Yeah.
Q Okay.
A Which sites of the water distribution system received contaminants from which well.
Q Okay. In the Dover township study, am I correct that that did not include any contaminant mass loading modeling?
A No. No.
Q It --
A Whatever --
Q Meaning it did not include that?
A No, it did not.
It just looked at the -- how the water coming from wells are distributed in the water distribution system.
Q Okay. And did it involve -- it -- sorry.
It did not involve contaminant biodegradation --

A No.
Q -- modeling.
A No. I don't think so.
Q Okay. And were there fewer than ten well fields involved --
A I -- I --
Q -- in that model?
A -- have to read the report to answer that honestly.
Q Okay. And did it involve modeling anything outside of the distribution system?
A No.
Q Okay. That's all I wanted to ask you about this one.
A Okay.
MS. O'LEARY: And can we get 64?
(Whereupon, Government's Exhibit Aral 24, USGS Water Resources Investigations Report, was marked for identification.)
BY MS. O'LEARY:
Q Professor Aral, this will be Government Exhibit 24.
And -- so Professor Aral, the document -- or Exhibit 24 says it's the "Fate and transport

modeling of selected chlorinated organic compounds at hangar 1,000, U.S. Naval Air Station Jacksonville, Florida." And it says it's by the USGS Water Resources investigations report and it has its number.

A Uh-huh.

Q Is this the report you were discussing in your --

A Yes.

Q -- report when you said --

A I think so.

Q -- when you mentioned the Jacksonville Naval Air Station?

A That's correct.

Q Okay. And can you go to page two of this report, which is a few pages in?

A Uh-huh.

Q There's a section called, "Purpose and scope," in the right-hand column.

A Uh-huh.

Q And it says, "A computer model capable of simulating the groundwater flow and the fate and transport of trichloroethylene, dichloroethylene, and vinyl chloride in the groundwater at hanger 100 -- 1,000 was needed by the Navy to aid in

remedial decisions.

"The purpose of this report is to document the development of this model which simulates groundwater flow in solute transport and presents the results of the model predictions. The computer modeling effort consisted of one updating existing large scale groundwater model to simulate groundwater flow in the vicinity of hangar 1,000, establishing boundary conditions for a site specific model with the large scale model, and predicting the movement of contaminants at hangar 1,000 through solute transport simulation using the site specific model."

So do you agree that the purpose of this naval air station in Jacksonville modeling was to aid in remediation?

A Yeah.

Q And that is looking to the future? Like, using the present to look at what to do in the future, is that correct?

A I think it looked at the past contamination and how it spread over the region. If -- I don't recall exactly what it did look -- but it could have looked at the past contamination as well --

Q Oh.
A -- but the purpose was remediation.
Q Yeah. And I don't disagree about having looked at the past --
A Right.
Q -- but, I mean, the purpose was for --
A Yeah, yeah, yeah.
Q -- predicting what would happen --
A Yeah.
Q -- in the future.
A Exactly.
Q Correct?
That's the purpose on remediation, is --
A That's right.
Q -- where it's going, where should we clean up.
A Uh-huh. Uh-huh.
Q And still on -- or actually, if we could go to page 49?
A Uh-huh. Yes.
Q Okay. There's the column on the left on page 49, the second paragraph, it starts, "Simulation." "Does a simulated" -- oops, excuse me. I'm in the wrong spot. Huh.
Do you know what the time frame for the

running of the model on Jacksonville, Florida Naval Air Station was?

A I wouldn't know that.

Q Okay.

MS. O'LEARY: And that's all I wanted to ask you about that. If we could go to --

THE WITNESS: Okay.

MS. O'LEARY: -- thirty-one.

(Whereupon, Government's Exhibit Aral 25, EPA Superfund Record of Decision, Tucson International Airport Area, Arizona, was marked for identification.)

BY MS. O'LEARY:

Q There you go --

A Thank you.

Q -- Professor Aral.

MS. O'LEARY: And what's the exhibit number? Is this 25?

MS. HORAN: That's right.

BY MS. O'LEARY:

Q Okay.

A Yeah.

Q So we've got Exhibit 25. It says it's

"EPA superfund record of decision, Tucson International Airport Area" --

A Yeah.

Q -- "Arizona."

Is this what you were citing in your report in one of the area -- examples of --

A Uh-huh.

Q -- the use of --

MR. DEAN: Objection.

BY MS. O'LEARY:

Q -- historical water modeling?

A This -- this is -- if I recall this correctly, this is a site where site data was -- was used historically to determine what was going on at the site.

Q Okay.

A This reference, I put it in there implying that site data can be used, modeling can be used, statistical analysis can be used. So historical construction can be done many different ways.

Q Uh-huh. Are you familiar with this superfund record of decision?

A I remember reading it but I don't remember right now what it says.

Q Okay. Can you just go to the second page, the back of the first page?
A Okay.
Q And in the middle, there's a -- there's an abstract and it's box 16.
A Okay.
Q Okay.
MS. BAUGHMAN: Sorry. What page are you on?
MS. O'LEARY: The back of the first actual page of the document. It doesn't have a number. It's --
THE WITNESS: The ab- --
MS. O'LEARY: There are boxes on it. Yeah.
THE WITNESS: The abstract you are referring to?
MS. O'LEARY: Uh-huh.
THE WITNESS: Okay.
MR. DEAN: Can I see it for a second?
BY MS. O'LEARY:
Q Okay. So --
MS. BAUGHMAN: That's -- yeah.

BY MS. O'LEARY:

Q So the abstract says that, "The Tucson International Airport area site encompasses sections of southwest Tucson and adjoining land south of the city of Pima County, Arizona -- or the city in Pima County, Arizona.

"The site is located in the Tucson basin and includes industrial, commercial, residential and undeveloped areas as well as the Tucson International Airport, the U.S. Air Force Plant number 44, AFP 44, and part of the San Xavier Indian Reservation. The Santa Cruz River borders the site to the west.

"The groundwater system in the Tucson basin has been designated as sole source aquifer. Before the discovery of groundwater contamination in the TAA wells within the site boundaries provided water for over 47,000 people. At least 20 facilities have operated in the TAA since 1942. These include aircraft and electronics facilities which discharged waste liquids directly to surface soil.

"Fire drill training areas where uncombusted residual wastes from training operations were left in unlined pits and unlined --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q -- "and unlined landfills which received various wastes from several sources. The first indications of groundwater contamination in TAA appeared in the early 1950s when elevated levels of chromium were detected in municipal supply well adjacent to AFP44 in the southern portion of the site and residents in another area complained of foul smelling water from private supply wells. In 1976 the well was closed at AFP 44 by the state because of high levels of chromium.

"By 1988, additional sampling by the Air Force and EPA had indicated the presence of VOCs in the groundwater. Consequently, in 1981, the City of Tucson began closing all municipal wells that exceeded the state action level for the principle contaminant TCE and notified private well users of potential risks.

"The site was divided approximately in half along Los Reales Road with the Air Force" --

(Whereupon, the court reporter requests clarification.)

BY MS. O'LEARY:

Q "Los Reales Road with the Air Force addressing contamination to the south and EPA addressing contamination to the north.

"In 1987, the Air Force began operating its groundwater pump and treatment system using ion exchange and packed column aeration followed by reinjection into the aquifer. This rod addresses the groundwater contamination in the northern portion of the site which, together with the Air Force remedial groundwater system, constitutes the overall groundwater remedy for the site.

"The northern portion of the site has been divided into two discrete areas, A and B. Area A lies west of the airport and extends approximately three and a half miles to the northwest in the direction of groundwater flow and is generally less than a mile wide.

"Area B consists of two smaller separate areas north of the airport. It fur -- it further -- if further investigations indicate that there is soil contamination and that it is a source of continuing groundwater contamination, a rod will be developed to address soil remediation. The primary contaminants of concern effecting groundwater are

VOCs including TCE, benzene, and xylene."
So is this project also about remediation?
MR. DEAN: Object to the form. The document speaks for itself.
A Yeah, it is about remediation --
BY MS. O'LEARY:
Q Okay.
A -- but there is some population -- there's a mention of population living in the vicinity of about what, 50 -- 47,000 people.
Q Yeah.
A So I don't know how they would resolve the contaminant distribution, remediation, or they don't want to look at the health effects maybe of whatever --
Q I mean --
A Whatever --
Q Go ahead.
A Whatever the decision is for U.S. EPA or U.S. -- who is doing this? I remember --
Q So --
A This is the -- this is the record of decision. Okay.
So I think they are looking at

remediation here.

Q Is there any discussion here of historical reconstruction of a water model?

A Well, I think they -- as I said, the water modeling analysis can be done looking at model outputs, statistical outputs, or site data.

The reason I have included this reference is that this reference doesn't use modeling, it just looks at the site data and tries to understand how they can manage the system for remediation without doing a modeling. As far as I know, that's the purpose I put that in there.

Q Okay.

MS. O'LEARY: All right. That is it. I'm all finished.

Thank you, Dr. Aral --

THE WITNESS: Okay.

MS. O'LEARY: -- or Professor Aral.

THE WITNESS: Thank you.

MR. DEAN: No questions.

MS. O'LEARY: Okay.

MR. DEAN: Have a good evening.

MS. O'LEARY: Then we are done.

THE VIDEOGRAPHER: The time right now is 5:16 p.m. We are off the record.

(Thereupon, the deposition was concluded at 5:16 p.m. EST.)

C E R T I F I C A T E

I hereby certify that I am a Notary Public, in and for the State of New York, duly commissioned and qualified to administer oaths.

I further certify that the deponent named in the foregoing deposition was by me duly sworn, and thereupon testified as appears in the foregoing deposition; that said deposition was taken by me stenographically in the presence of counsel and reduced to typewriting under my direction, and the foregoing is a true and accurate transcript of the testimony.

I further certify that I am neither of counsel nor attorney to any of the parties to said suit, nor am I an employee of any party to said suit, nor of any counsel in said suit, nor am I interested in the outcome of said cause.

Witness my hand and seal as Notary Public this 10th day of February, 2025.

____

Clifford Edwards

New York Notary ID Number: 01ED6430906
Notary commission expires: 3/28/2026

J U R A T

I have read the foregoing 381 pages and hereby acknowledge the same to be a true and correct record of the testimony.

____

MUSTAFA MEHMET ARALU

Subscribed and sworn to

______________________________.

Before me this _____ day of ____________________, 2025.

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Notary Public

My Commission Expires:

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